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POWER

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Josiah Hornblower

LAST week the American Section of the Newcomen Society, of Great Britain, erected in the little churchyard at Belleville, N. J., where he is buried, a tablet to the memory of Josiah Hornblower.

Comparatively few people even in steam engineering circles ever heard of him.

He brought to America, set up and ran the first steam engine that was ever operated on this side of the Atlantic.

It was one of those engines that Thomas Newcomen had developed out of the efforts of Papin, Savary and others and that had come into considerable use for pumping purposes in the Cornish mines.

Josiah's father and brother made a business of putting in these engines, and when an order came from America for one to pump out a copper mine on the Schuyler estate on Newark Bay, Josiah was entrusted with the job of putting it into service.

The engine was delivered in 1753, when James Watt was only seventeen years of age. It was by his improvements upon it, conceived when working upon a model as instrument maker at the University of Edinburgh, that Watt adapted this type of engine to wider usage and laid the foundation of this Age of Power.

The effects of this development have become so general, such commonplace features of our daily life, that few realize the extent to which in manufacture, transportation and utilitarian services modern civilization is dependent upon power produced by steam.

Consider your own case. How many of the articles of comfort and convenience, of ornament and culture, that furnish and adorn your home could you afford if they had to be made by hand? To what extent are you dependent upon power for employment, for ability to get about, for water, light, fuel and food supplies?

Imagine how the tenor of your own life would be affected if every steam engine were shut down for a week.

And then realize that all this development has taken place in so limited a time that the man who ran the first, and for years the only steam engine in America, was buried where this tablet is erected only one hundred and twenty-one years ago.

F. R. Low

POWER *Stands for . . .*

1. **Making Power When It Should Be Made**
2. **Buying Power When It Should Be Bought**
3. **Cheaper Power Through Modern Equipment**
4. **Easier Financing of Equipment Purchases**
5. **Better Use of Byproduct Heat and Power**
6. **Operating Methods That Save Money**
7. **Less Waste in Transmission and Application**

The Vernal Season

SPRING is the traditional time for cleaning, when the housewife goes about with a towel pinned around her head, broom in hand, and mere man scuttles to the most convenient haven of refuge. All in the home is made bright and shining, while worn or broken things are repaired or renewed.

This is a custom that can be imitated with profit by the power plant. In spring, when the heating and lighting load is somewhat less than in winter, there is opportunity for a thorough going-over of all the valves, pipe lines, joints and other parts that may need repair.

From this investigation will grow a list of maintenance jobs that should be done. These, arranged in order of importance or convenience, give a schedule for working in the slack periods of summer. Faithfully carried out, this system of "spring housecleaning" gives a plant that by fall is freshly tuned up for the winter peak loads.

Power Supply for Office Buildings

THE fact that last week two local sections of the American Society of Mechanical Engineers had the office building power plant for a subject of discussion may be taken as indicative of a renewal of interest in this type of power plant.

The War held up office and hotel building construction, so that when material and money became available, the demand for building space was so great that the necessity was to supply the new building rather than to furnish office space at a low rental. The efficiency made possible by the proper combination of heating and power generation received scant sympathy. Based on the idea that the high wage scale that remained after the War and the increased cost of fuel were unsurmountable obstacles, the custom arose of installing low-pressure boilers.

Apparently, the demand for new buildings has been more than met, for rentals show a downward trend. Economy of operation is imperative if net returns are to be satisfactory, and as the expenditure for heat and power is a considerable item, owners and agents are showing more interest in this part of the structure.

There can be no particular method or apparatus that is the best for all installations. In many instances, especially when the heating season is short, the low-pressure boiler and electrical energy from the outside is the most economical combination.

In other circumstances it will pay to develop power from engines or turbines whose exhaust serves the heating system, and to buy power during the summer.

Still other buildings will find all year operation of the generating units economical. An objection often raised to this method is the high steam consumption chargeable to power generation during the summer months. This is true for non-condensing operation, but there is no reason why certain building plants should not install condensers and spray ponds or cooling towers on the roof.

Of course there are many situations where condensing equipment cannot be used, and there exists a general feeling that this precludes a building power plant. Undoubtedly, it may not be economical to operate steam engines during the summer, but a combination of steam and oil engines has advantages, for the steam engine's steam feed can be made equal to the heating demand, with the remainder of the power generated by oil engines. Or the steam engine can be eliminated and all power be developed by oil engines.

The application of Diesel engines to office buildings is one that is still in its infancy. It does offer attractive possibilities, as it can be used in conjunction with existing low-pressure heating boilers. The load is ideal for oil-engine operation, for the variations in demands are small, much under those in an industrial plant.

Other combinations might be cited, but the proper one for a given building requires a careful study by the architects, something that has frequently been absent in office-building design.

Making Money Often Means Spending Money First

PERHAPS the greatest motive actuating the business methods of many people is the attempt to get something for nothing. Not satisfied with a legitimate return for their activities, whether these be in the form of work or of potential work, which is capital invested, they wish to receive dividends or make a saving where they have contributed nothing.

Many plant managers have the same attitude toward power. Unwilling to make a proper investment in power generation or application facilities, these men expect their plant to produce goods at as low a cost as do the plants of their less parsimonious competitors.

In all industries there is a drive to reduce manufacturing costs. Because of this, one plant engineer recently checked over all the machine drives in his plant, hoping to find a way of reducing power consumption. His study brought to light many drives that were not giving the

best results. He reported this to his management, showing the saving in power costs that could be made by some changes in the machine drives.

Of course the first question asked by the management was "How much will it cost?" On finding that the improvements would not return their cost in savings the first year, but would require slightly over two years to make this balance, the proposition was turned down.

This was undoubtedly a very short-sighted move on the part of that management. Evidently, they had not learned the lesson that making money in business means spending money first. Clear-sighted managers should expect improvements to pay for themselves in three or four years. To expect this to be accomplished in one year is not sensible.

Heat Now Wasted Might Yield Profit

BY FAR the greatest power losses occurring in the average industrial plant arise from the waste or improper use of heat. All sorts of heat-using process equipment, whether it be driers, evaporators, stills, reaction vessels or what not, is capable of more economical operation that it generally receives.

This has been clearly brought out in many industries, but nowhere more so than in cement manufacture, where what has been accomplished might well serve as an example for others to follow. Some cement plants—not many, it is true—now generate all the power needed from the waste heat of their kilns and driers.

This results in a considerable saving in manufacturing cost and fully justifies the investment needed. Of course, but few industries can duplicate this achievement, but there is some saving to be made in almost any plant that uses heat in its processes.

Slag from Hot-Bottomed Furnaces

THE use of the so-called "hot-bottomed" furnaces at the Huntley Station, Buffalo, and at the Toronto, Ohio, station appears to have amply justified the claims made for this construction as a satisfactory means of handling powdered coal ash, but the disposal of this slag, other than as fill, is still an unsolved problem.

The chemical composition of such ash depends on the nature of the coal burned. In general it will consist of silica, alumina and iron oxide. The material, if allowed to cool, assumes a glass-like formation, is very hard, and is inclined by its nature to be brittle. This mitigates against its use as a cast brick for construction purposes unless a new manner of casting is devised. There is hope of progress in this direction, for blast-furnace slags have been used as building blocks in Europe for generations. A glass-like slag brick would be suitable for use as a hard-burned outer brick for buildings, as it should be highly resistant to atmospheric disintegration.

Possibly some electrochemical treatment may be given this liquid slag to produce some useful material either by direct treatment or by admixture with other substances. For instance, ash from certain Nova Scotia coals contains almost as much iron as commercial iron ores. Little thought seems to have been given to these possibilities. If it were possible to develop useful products from this material, not only would the waste ash assume a value, but the added electrical furnace load would provide another use for electricity and improve capacity factor. A study of the use of hot-bottomed furnaces may thus lead to the development of valuable economic products from powdered coal ash which, up to the present, has been largely a nuisance. Whatever the use to which such slag may be put eventually, it will necessarily be one that can utilize large bulk.

Water Power Grows in Importance

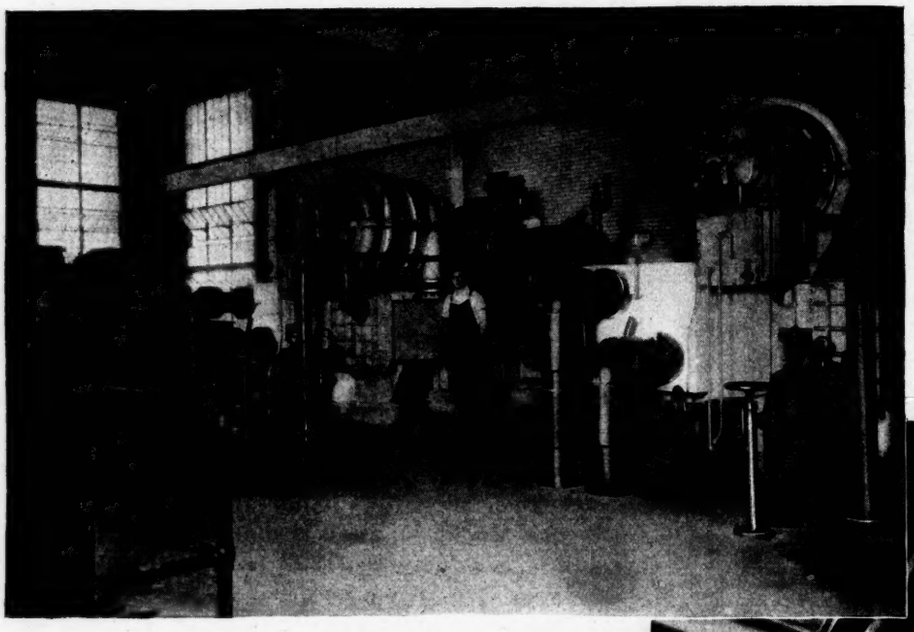
A RECENT report made by A. H. Horton, Chief of the Division of Power Resources of the United States Geological Survey, indicates that water power is more than holding its own, notwithstanding the steady growth in steam plants. It had been predicted that the percentage of the country's total power produced by water power in public-utility plants would begin to fall off before this time. Since 1919 more than one-third of the power generated in central stations has been produced by water, and last year hydro-electric plants supplied forty per cent, or thirty-five billion kilowatt-hours.

During the last four years the output from hydro-electric plants has increased more rapidly than from steam stations. This is remarkable considering that water-power developments are influenced by many factors and that in the last ten years the output of central stations has increased about one hundred and thirty per cent, or from thirty-nine billion to nearly eighty-eight billion kilowatt-hours.

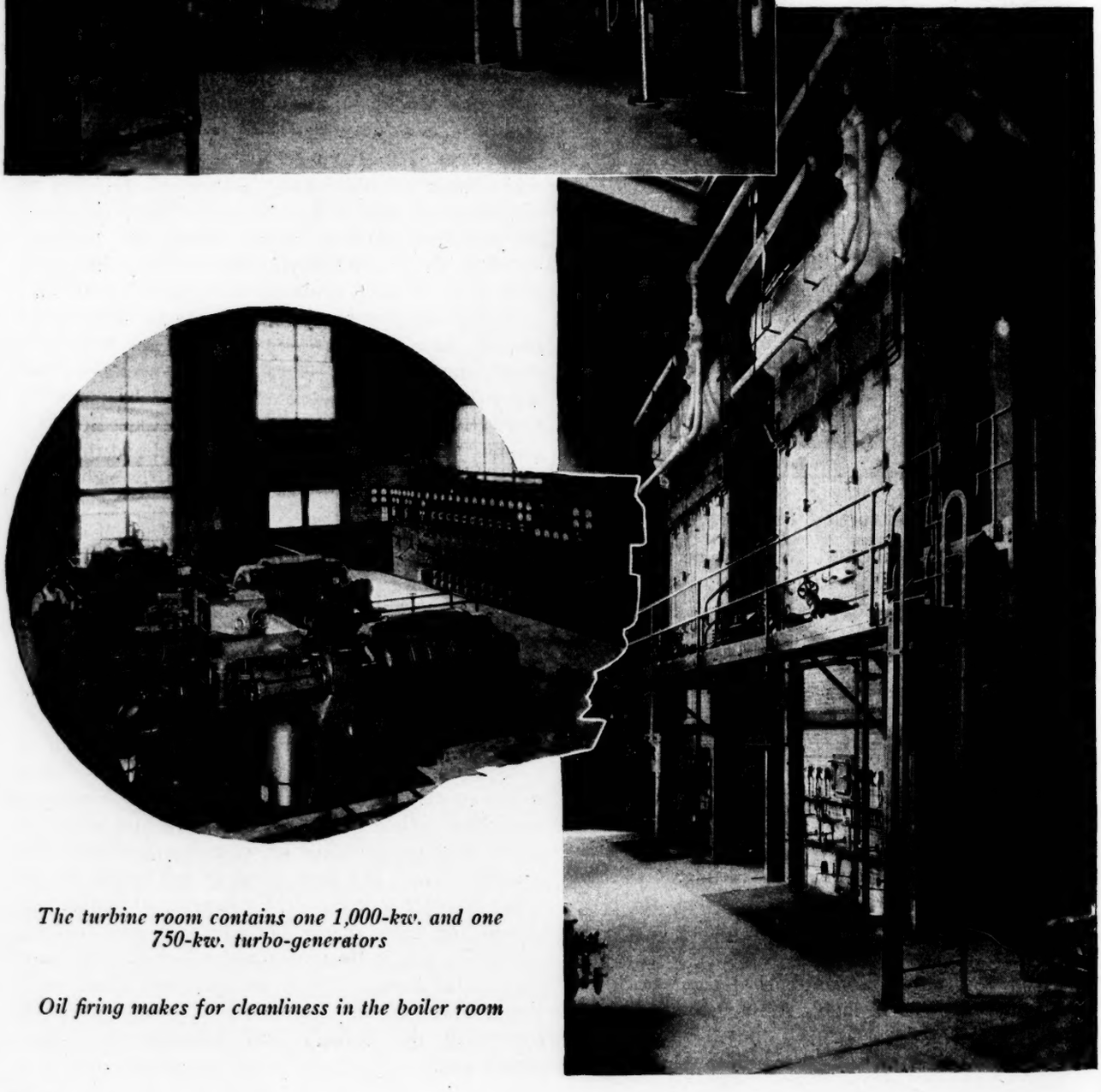
There has been a slowing up in water-power development in this country during the last year, but when steam-generated power will begin to gain on hydro-electric output would be difficult to predict. Many think that, aside from short-time factors, such as dry years, water power will continue to keep pace with steam for some time to come. Judging from past records, there seems to be fairly sound reasons for this belief.

Based on the average rate of fuel consumption of 1.76 pounds of coal per kilowatt-hour by central stations in this country last year, it would require the burning of over thirty million tons of coal to generate the amount of power that was produced by water-power plants. This amount of coal has been saved at no expense to our water-power resources. The processes of nature perpetuate the water supply, but when our fuel resources are used, a hole in the ground and a disfigured landscape are all that remain. With the increased utilization of water power it will become a still greater factor in conserving the nation's fuel resources for future generations.

Power Services Employed in M



A large amount of refrigeration is required in candy manufacture. The two 200-ton machines in the foreground and another of 100 tons are employed in air conditioning. Two of 75 tons capacity serve the cold storage rooms



The turbine room contains one 1,000-kw. and one 750-kw. turbo-generators

Oil firing makes for cleanliness in the boiler room

Making Schrafft's Chocolates

Condensing turbines supply extraction steam at 6 lb. for cooking and heating, whereas a small amount of live steam is supplied direct to process at 90 lb. Refrigeration demands for air conditioning and cold storage are met by five units of 650 tons total capacity.

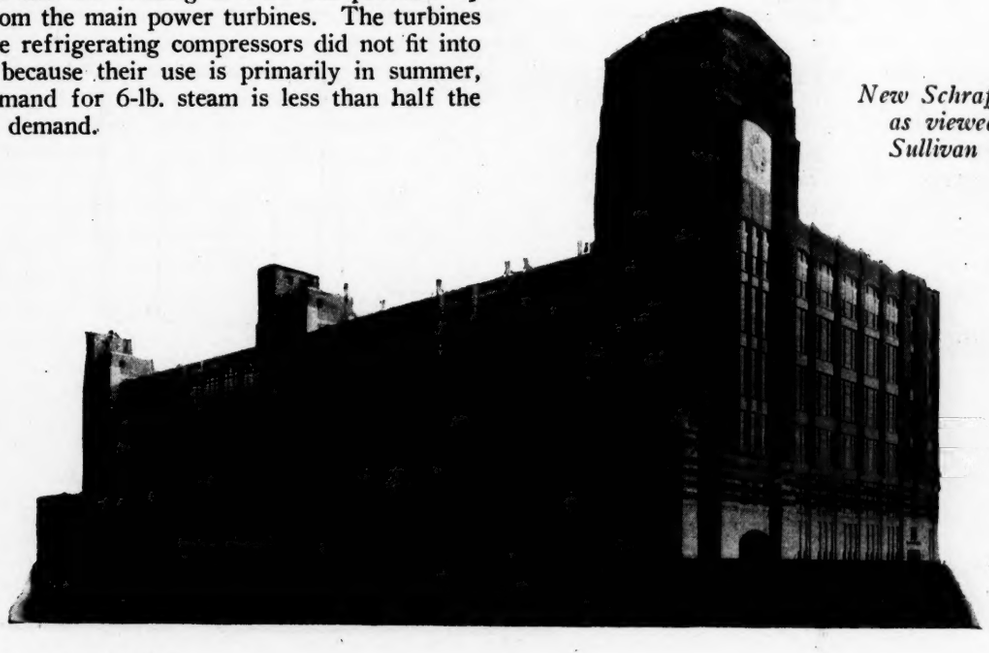
By D. D. Eames
Lockwood Greene Engineers, Inc., Boston

AT CHARLESTOWN, MASS., is located the new manufacturing plant of Wm. F. Schrafft & Sons Corporation, makers of the well-known Schrafft's chocolates. The building, which is on the banks of the Mystic River, covers a ground area of 200x480 ft., is seven stories high and, in addition to a complete candy-making equipment, contains cold-storage rooms, a box and printing shop, dining and recreation rooms, and the offices of the company. The numerous factory and building services required are supplied from a power plant housed in an adjacent building.

This plant was designed for the generation of as much byproduct power as could be profitably arranged. There were three demands for steam in the factory which might have been supplied after extraction of power; namely, 90-lb. pressure for cooking, 6-lb. pressure for cooking and 6-lb. for building heating. The demand for the 90-lb. steam was small and, as will be explained later, it would have cost more to extract it from a turbine than the resulting power was worth. The heating system was designed for 6-lb. pressure, and this steam, together with that for cooking at 6 lb. was provided by extraction from the main power turbines. The turbines that drive the refrigerating compressors did not fit into this scheme because their use is primarily in summer, when the demand for 6-lb. steam is less than half the cold-weather demand.

Alternating current is generated three-phase at 550 volts, 60 cycles and a small portion is converted to direct current at 230 volts by a motor-generator set. Refrigeration is supplied in two forms—chilled water at 34 deg. and brine at 10 to 15 deg. Demands for these various services are about as follows: Power, maximum 1,700 kw.; average day load, 1,375 kw.; average night load, 700 kw.; total kilowatt-hours per year, 6,500,000. The 6-lb. steam for process fluctuates widely but averages about 3,500 lb. per hour. The 6-lb. steam for heating is used in both direct and indirect radiation and ranges up to about 13,000 lb. an hour according to the weather. The 90-lb. process steam demand is from 3,000 to 4,000 lb. an hour. The total yearly steam demand amounts to about 160,000,000 lb. Refrigeration for air conditioning and cooling, furnished through the medium of the chilled water, amounts to a maximum of 550 tons, while that for the cold-storage room furnished by brine amounts to 150 tons or over.

The boiler load is fairly uniform throughout the year,



New Schrafft factory as viewed from Sullivan Square

the refrigeration load in summer offsetting the heating load in winter. Oil fuel is used and the operating steam pressure is 235 lb. with 60 deg. superheat. The main turbines are of the extraction and condensing type, whereas the refrigeration compressors are driven by straight condensing turbines. All the condensers are of the surface type. Auxiliaries, except the boiler-feed pumps and fuel-oil pumps, are motor driven. A vented condensate tank in the turbine-room basement receives the heating returns, surface-condenser drains and other drips, which are then pumped to the deaërating heater. Steam-driven auxiliary exhaust and all high-pressure drips go directly to the heater. The returns amount to 75 or 80 per cent of the total feed water.

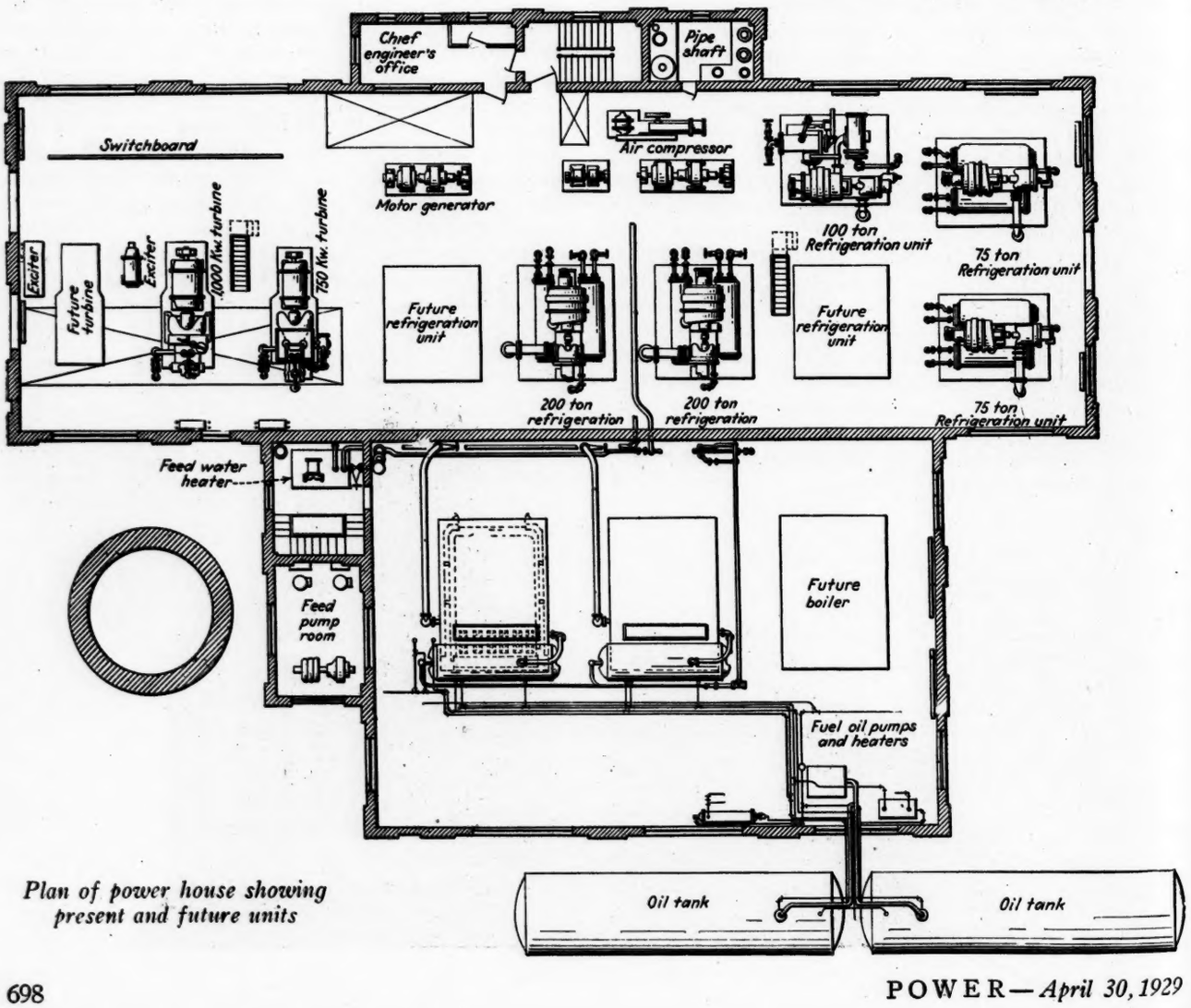
When the plant was being designed, the relative advantages of coal and oil were considered. The latter was chosen because of its cleanliness and its desirability for a candy plant where coal and ash dust might be objectionable. Oil is received in tank cars and stored in two 26,000-gal. buried steel tanks constituting eight or ten days' supply. A larger oil storage is not required because of the proximity of the refineries and the regularity of car deliveries. The oil is handled in the usual way by duplex steam pumps through heaters to the burners. Steam for oil heating at the unloading station and in the storage tanks and heaters is reduced to 20-lb. pressure. The burners are of the steam-atomizing type, with automatic oil, steam and damper control. There are six burners to each boiler arranged in a double tier, three in each row.

The boilers are of the cross-drum type, each having 5,190 sq.ft. of steam making surface. They are set singly and fired from the low end. The setting is 19 ft. high to the bottom of the headers at the high end, giving a furnace volume of 2,300 cu.ft. These boilers are carrying steady loads of 225 to 275 per cent rating with uptake temperatures of about 520 deg. The steam temperature is about 460 deg.

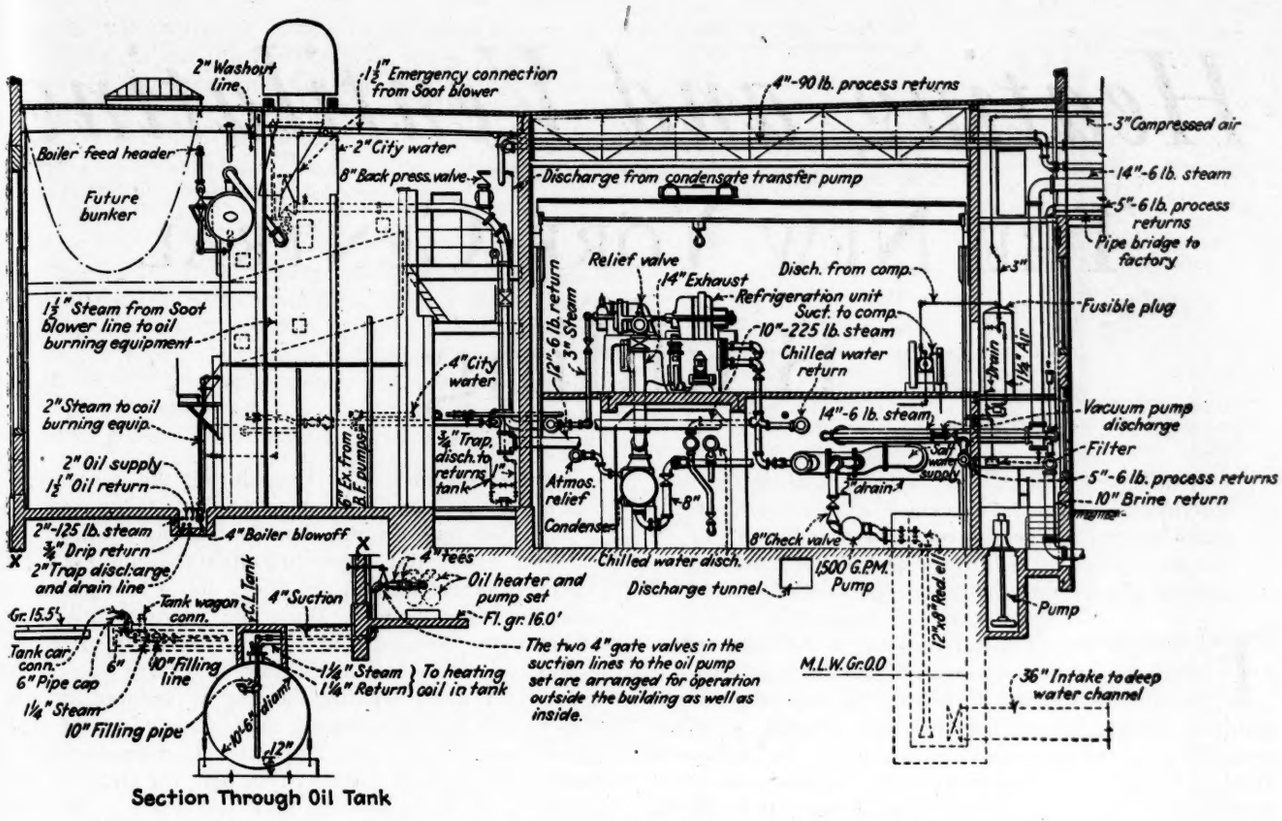
The settings have sectionally supported air-cooled walls, all air for combustion being drawn through the walls to a chamber underneath the burners, from which it passes through the checkerwork into the furnace. In its passage through the walls the air is heated to from 175 to 200 deg. and a double benefit is accomplished, in that maintenance on the walls is reduced by the cooling effect of the air and the furnace efficiency is increased by the preheating. No induced draft or other fans are used. When the boiler was operating at 250 per cent, the following draft readings were noted: At uptake, 0.65 in.; in furnace, 0.32 in.; in plenum chamber below burners, 0.24 inch.

A radial-brick stack, 200 ft. high by 10 ft. diameter at the top, serves the two present boilers but has sufficient capacity for four boilers at full capacity. The radial-brick lining starts at the foundation and extends up 75 ft. The smoke flue extends above the roof and enters the stack about 40 ft. above the ground.

There are three boiler-feed pumps, two vertical simplex reciprocating steam pumps, 12x8x24 in., and one turbine-driven centrifugal of 200 g.p.m. capacity. The



Plan of power house showing present and future units



Cross-section through boiler room and refrigeration end of turbine room

reciprocating pumps are intended for light-load periods and as spare capacity in case the turbine unit is out of service.

The 90-lb. process steam is supplied through a reducing valve from the 235-lb. header. Inasmuch as superheat is not wanted in this steam, a desuperheater has been provided. This is essentially a closed heater of special design, through which the 90-lb. steam passes with the feed water as the desuperheating medium. This type of desuperheater does away with the necessity of spray water as a heat-absorbing medium and has proved very effective. There is a further connection to the 90-lb. desuperheated steam line with a reducing valve to the 6-lb. heating and process system. This is primarily an emergency makeup connection as the full demand for this steam is ordinarily extracted from the turbines. Extraction of the 90-lb. supply from the turbines was also considered when the plant was designed, but the extra cost of the turbine was found too great to justify the small saving that would result.

A careful study was made to decide whether the electric power for the factory should be generated or purchased and the final analysis indicated a substantial saving in favor of the privately generated power. Several factors contributed to this decision, particularly the night load and the byproduct power generated by the 6-lb. heating and process steam before extraction. There are two turbine generators, one of 750 kw. and the other 1,000 kw. capacity. They exhaust into surface condensers with steam-jet air pumps and centrifugal condensate removal pumps. Independent steam- and motor-driven exciters are provided.

Salt water from the river is employed for condensing. In order that it might be available at low tide, a low-level pipe was laid from the deep-water channel of the river to the plant, a distance of about 600 ft. The power-plant end of this pipe, which is 36 in. diameter, terminates in a concrete suction well in the turbine room basement in which the water rises and falls with the tide. A traveling screen in the well is provided to keep fish and refuse from the pumps.

Three circulating pumps are provided, one of 1,500 g.p.m. capacity and two of 3,000 g.p.m. each. These stand on the basement floor at elevation 12. The suction pipe for each pump passes through the side of the well above the floor and drops down to eight inches from the bottom, thus being always submerged regardless of the state of the tide. No foot valves are provided, but steam ejectors are used for priming.

The refrigeration equipment consists of five centrifugal machines, two of 200 tons capacity and one of 100 tons for cooling water for the air-conditioning system in the factory, and two of 75 tons capacity for cooling brine for the cold-storage rooms. Each compressor is driven by a direct-connected turbine. These turbines are rated at 250 hp. for the large machines and 125 hp. for the smaller ones. They operate condensing, the condensers being the same type as for the large turbines, but grouped so that two condensers serve the five turbines, three small ones on one condenser and two large ones on the other.

The manufacturing building has been designed for a considerable increase of capacity beyond that represented by the machinery now installed and additional power-plant demands have been allowed for by leaving space for additional equipment.

The factory and power plant were designed by Lockwood, Greene Engineers, Inc., and built by the Turner Construction Company in 1927 and 1928. L. P. Leathers is mechanical engineer for the Schrafft company, and was in charge of all the new work. C. F. Hill is chief engineer of the power plant.

Heating and Ventilating

THE NEW YORK CENTRAL Building

Roadways through the building and lack of basement have made necessary a somewhat unusual heating system layout. Another feature of the heating system is the type of radiator used and method of recessing them under windows.

THE New York Central Building is the most recent addition to the group erected over the tracks of the New York Central Railroad. It enjoys a unique position directly behind the Railroad terminal so often referred to as the gateway to a continent. Its location is further enhanced by being on Park Avenue, which it bridges, the roadways passing on both sides of a central lobby.

The building occupies a ground floor area of 68,000 sq.ft. and the tower section extends from the sixteenth to the thirty-fifth floor.

The architects, Warren & Wetmore, have made more than the usual service provisions. Thirty-two high-speed signal control elevators have been installed to serve the tenants and special provisions have been made for ventilation, gas, electric and telephone services throughout the building. Also railroad executive offices on the thirty-second to thirty-fourth floors required special treatment.

Steam for heating is furnished at 145 lb. pressure from a plant operated by the railroad in the basement of the Commodore Hotel. It enters the east side of the building in a six-inch diameter main, which divides into a six-inch main for winter use and a four-inch main for special services and summer use. An orifice meter is installed in each of these branches for measuring the amount of steam used.

These two mains rise to the machine-room mezzanine floor where the various reducing valves are installed. Fig. 1 is a plan of this piping and shows that steam is distributed to the building through five main branches: main building heating, ground to fourth floor heating, executive offices, hot water heating, and laundry and restaurant kitchen.

To facilitate operation, separate pressure reducing valves were installed for each of these main divisions of the heating system. Thus, during the summer the main heating header may be shut down and the steam needed for heating water supplied from the special header through a reducing valve of proper size for the required steam flow. Also, during the winter evenings it may be found economical to shut off the steam to the main building heating, but to continue heating the four lower floors, thus depending upon the building draft to carry sufficient heat to the floors above to maintain a reasonable temperature. With the valve arrangement that has been provided it will not be necessary to reduce the pressure of a small steam flow by a large valve.

Steam for main building heating is reduced in two stages to two pounds pressure and delivered to the pipe space between the fifteenth and sixteenth floors through a sixteen-inch diameter riser. From here the steam is distributed up to the thirty-first floor and down to the fifth floor. Fig. 2 shows the distributing mains in this pipe space, which are arranged in eight sections, four serving the tower and four serving the main building down to the fifth floor.

Each of the sections is equipped with remote control valves that may be operated by compressed air from a panel in the machine room, and each riser branch is valved so that it can readily be shut off in case of necessity. Remote control of the various sections permits reducing or modulating the steam flow to the sunny side of the building, thus preventing overheating.

Distribution of steam to the fourth to ground floors is complicated, because of the division of the building into three parts by the roadways that pass through it.

Four branches leave the reducing station for heating the lower part of the building. A ten-inch line crosses

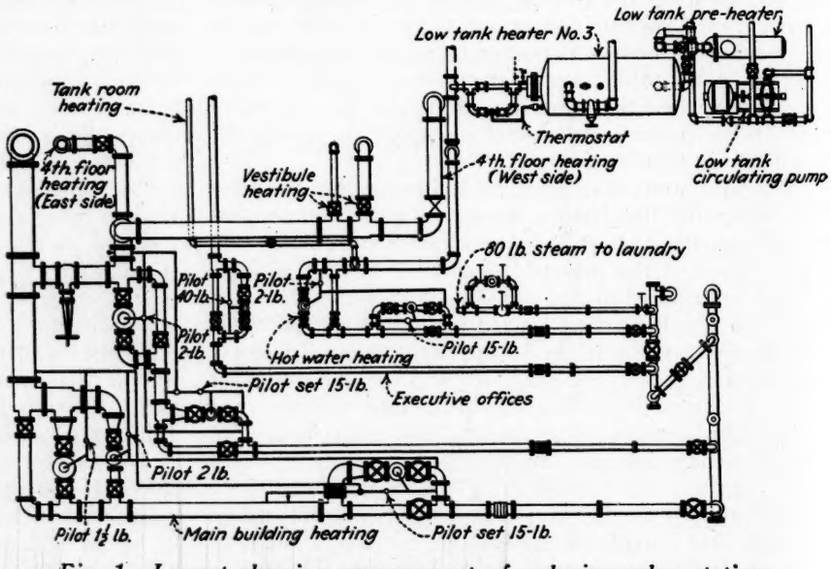


Fig. 1—Layout showing arrangement of reducing-valve stations on machine-room mezzanine floor

under the roadways, rising in the west section of the building to the fourth-floor pipe space where it distributes down to the west side and center section radiators. An eight-inch line rises in the east side of the building, distributing from the fourth floor to the radiators in that part of the building. The other two lines supply steam for vestibule, lobby and store heating.

Vestibule and Lobby Heating

Special hot-blast heating has been provided for both the north and south vestibules. Fig. 3 shows the equipment for the south vestibule.. A 10,000-c.f.m. fan draws air from a grill over the outside doors, through oil filters and vento heaters and delivers it to both sides of the vestibule. Provision has been made for recirculatig a portion of the air. The building draft draws the heated air in from both vestibules, thus heating the lobby. A small amount of direct radiation has been installed in the lobby to supplement the indirect heating. The vento heaters have been divided into two main sections. One section heats only the fresh air and is controlled by a thermostat in the cold air supply duct. The other section heats both the recirculated and the tempered fresh air. Thermostatically controlled valves, operated by compressed air, also regulate the steam flow to these sections of the heaters. In addition the fan motor is provided with a two-speed push-button control so that the air supply can also be varied. The vento heater, seen at the right in Fig. 3, supplies tempered air to the north vestibule.

In order to supply steam for a proposed restaurant in the executive offices, a line carrying steam at 30 lb. pressure was run direct from the reducing valve station to a pipe space in the ceiling of the thirty-first floor, where steam for heating the thirty-second to thirty-fifth floors is reduced to two pounds pressure. Distribution to these floors is from a header in this pipe space. Here also the returns from the executive offices are collected and brought down to the machine room.

The main building returns are collected on the fifteenth- and fourth-floor pipe spaces, and in the machine room join the returns from the executive offices in a main-return header. A duplex-centrifugal vacuum pump having capacity to handle condensation from 100,000 sq.ft. of equivalent radiation removes air from the system and pumps the returns through two plumbing water preheaters and thence to the sewer through a mixing tank. In this tank cold water is mixed with the condensate in order to reduce its temperature to 90 deg. before discharge to the sewer. A thermostat regulates the cold water supply, which will be required only in case of an overload on the heating system or when the preheaters are out of service.

The returns from the radiators on the fourth to ground floors are handled by a 65,000-sq.ft. duplex centrifugal vacuum pump in the girder space below the machine-room floor. This pump also delivers to the water preheaters and sewer through the mixing tank. Lift fittings installed in the returns from the lower floors made the installation of this pump necessary.

Drips from the risers and mains are kept separate from the returns and are collected in the girder space, where they are trapped to the 65,000-sq.ft. vacuum pump. Drips from the high-pressure piping are used in a special water preheater.

Final heating of the plumbing water is accomplished in two large heaters on the mezzanine floor of the machine room, and a third heater has been installed for emergency use. Steam for these heaters is furnished at two pounds

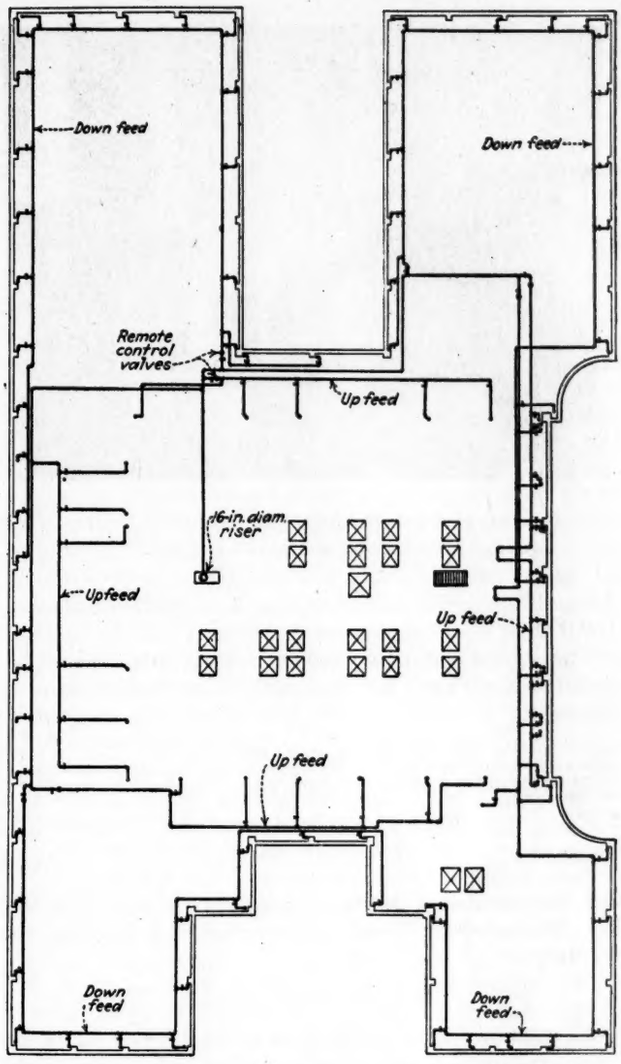


Fig. 2—Plan of fifteenth-floor pipe space showing steam distribution to main building heating system

pressure and the condensate is pumped back through the water preheater. A thermostat on each heater regulates the steam flow so that the water is kept at 140 deg. During the winter the condensate is handled by the main vacuum pump, but for summer months when the heating system is shut down, the condensate is taken care of by two pumps installed for that purpose.

Hot-water service is divided into two systems, one serving the tower and the other serving the lower floors, and forced circulation is maintained in each system. One of the two pumps installed for this purpose may be seen in the foreground of Fig. 4.

Other pumps in the machine room are a 1,000-g.p.m. fire pump, two low-head 150-g.p.m. house pumps and two high-head 150-g.p.m. house pumps. The low-head pumps deliver to house tanks on the sixteenth floor, and the high-head pumps to tanks on the tank-room floor above the thirty-fifth floor.

All the radiators are of the flat-flue legless type and are recessed under the windows. Enclosures have been installed which leave the front of the radiator entirely exposed but cover over the space between the pilasters and the radiator. A grilled window sill and a grill at the floor allow air to circulate through the radiator flues. The effect produced by the arrangement can be seen in Fig. 5.

Fig. 3—Fan and vento heater that supplies tempered air to fourth-floor work spaces

Fig. 5—Typical flue type radiator and enclosure recessed under window

A total of 2,992 radiators has been installed, having 110,000 sq.ft. of equivalent radiation.

The square feet of equivalent radiation is divided between the various divisions of the heating system as follows:

	Sq.Ft.
Main building heating, fifth to thirty-first floor	75,386
Executive office heating	9,000
Building heating, ground to fourth floor	39,050
Vestibule	10,050
Stores	2,808
Hot-water and tank-room heating	3,400
Total	139,694

It is estimated that during zero weather a total of 56,000 lb. of steam per hour will be required to heat the building.

Building Ventilation

Ventilation of the building may be classified under six main services: Toilet, executive offices, elevators, workspaces, vestibules and special tenant ventilation. Both supply and exhaust ventilation is provided for the executive offices and elevator machine room, while only exhaust is provided for the toilets. Twenty fans have been installed for the work.

Three fans on the thirty-fifth floor exhaust air from all the toilets in the building. They have a combined capacity of 78,725 c.f.m. The fan shown in Fig. 6 ventilates all the toilets on the east side of the building from the ground to fifteenth floor. The two other fans also serve a definite section of the building, one ventilating the toilets in the tower and the other those in the west and central portions of the main building from the ground to fifteenth floor. No interconnection has been provided between the main-exhaust systems.

Experience has shown that high-speed elevator machines, motor-generator sets and other equipment in the elevator machine rooms generate enough heat to make ventilation of these rooms necessary if overheating of the elevator motors is to be prevented. One of the fans that supplies fresh air to these rooms is in the pipe space between the fifteenth and sixteenth floors and serves five elevator machine rooms. The other fan, serving three rooms, is on the thirty-fifth floor. Together, these fans furnish 19,500 c.f.m. No provision has been made for tempering the air supplied by these fans during the winter months.

The exhaust system for these rooms is connected to the toilet exhaust ducts, provision having been made for removing a total of 18,150 c.f.m. from the eight machine rooms.

A complete supply and exhaust system of ventilation has been installed for the railroad executive offices. Outside air is drawn in through a vento heater having

Fig. 4—The water preheaters are seen at the right and the main heaters at the left

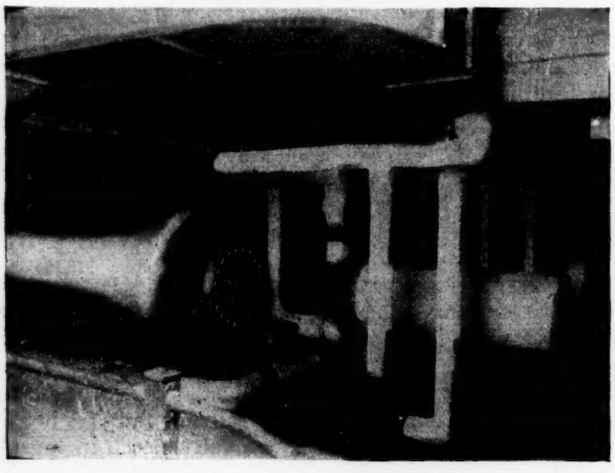
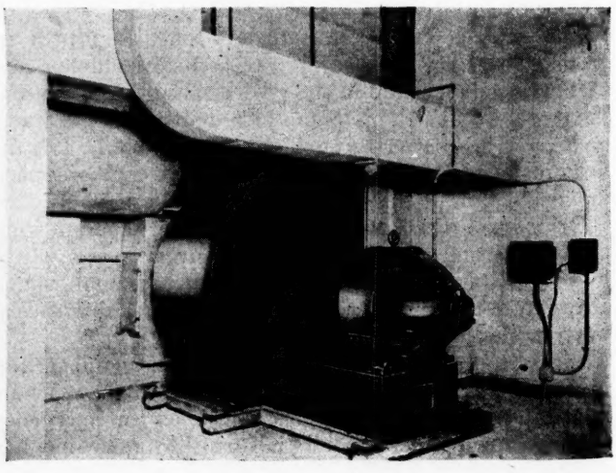


Fig. 6—One of the three fans used for toilet ventilation



418 sq.ft. of heating surface and delivered by a 10,000-c.f.m. fan to registers on the walls near the ceiling. Exhaust air is removed through registers near the floor by a fan of somewhat less capacity. The air supply has been made larger than the exhaust because of a number of open fireplaces, which, when used, will consume a considerable amount of air.

Special tenant ventilation has been provided for a restaurant on the street-floor level and a large barber shop on the fourth floor. The 5,000-c.f.m. supply and exhaust fans for the barber shops are in a pent house on the fifth floor roof. The supply air is filtered by a stream-line automatic oil filter and tempered by vento heaters. A thermostat actuated by the outside air temperature controls the steam flow to the heaters.

Fans for the restaurant ventilation are installed in a

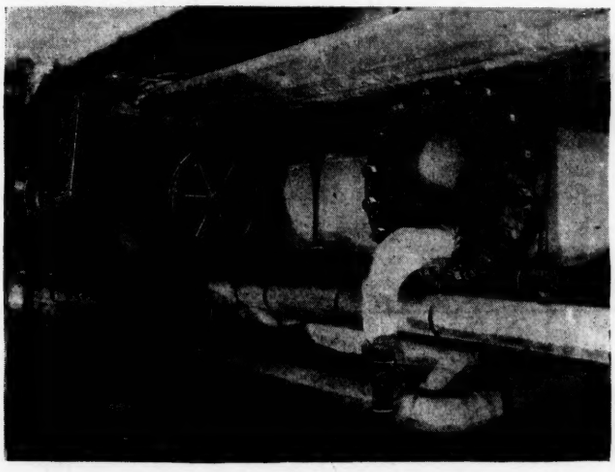


Fig. 7—Fifteenth floor pipe space

sort of plenum chamber on the second floor of the west section. Two fans supply filtered and tempered fresh air. One serves the kitchen and other restaurant work spaces, the other serves the dining-room space. The two systems were installed because a somewhat higher supply air temperature is required in the dining room than in the kitchen.

Both of these spaces are served by one exhaust fan, which discharges into the fanroom and thence through grills in the building walls.

Future ventilation requirements have been anticipated and provided for by the installations of ducts wherever such requirements seemed likely. It is expected that, for the most part, this future ventilating will be required for private toilets installed by tenants.

Power wishes to acknowledge the co-operation and assistance given by Charles Holtge, of Warren & Wetmore, and of C. P. Benneche, mechanical assistant to the superintendent of the New York Central Building.

WHEN A STEAM ENGINE IS IDLE, there is a possibility that the oil on the cylinder wall will evaporate, particularly if the cylinder is at a high temperature just prior to shutting down. Then, when the time comes to start up again, the cylinder may be dry and rusty. It is always a good plan to increase the oil feed just before shutting down, so that there will be every opportunity for a thick film of oil to form for protective purposes until the engine is to operate again.

Use Stack Capacity Tables for Ratings Above Normal

BY C. O. SANDSTROM
Los Angeles, Calif.

THE subject of chimney draft is so complicated with variables that in practical design recourse is frequently had to empirical formulas that are, when used intelligently, sufficiently generous to insure successful operation. Tables like those in Kent's "Mechanical Engineers' Pocket Book," based on the consumption of five pounds of coal per ten square feet of boiler heating surface satisfy the requirements of ordinary operation. It is when high ratings are desired that there is chance of error when using chimney tables. The error I have in mind is no reflection on the tables, however, but is one of application.

Several times I have learned of propositions to obtain high boiler ratings with chimneys of diameter- and height-combinations that were somewhat puzzling. Recently, however, I had the opportunity to follow the process of a chimney selection, which threw light on a number of previous cases.

Referring to the Kent table, we find that a stack four feet in diameter and 100 ft. in height will provide sufficient draft for a boiler of 3,480 sq.ft. burning five pounds of coal per square foot of heating surface. Increasing the load on a boiler necessitates an increase in fuel supply, which in turn increases the volume of stack gas and its velocity through the setting and stack. In a natural-draft chimney there are two ways of increasing the velocity of the gas—increasing its temperature, and increasing the height of the stack. Increasing the gas temperature has early limitations. First, it entails a loss of heat and, second, a temperature is soon reached that ceases to be effective in increasing the weight of gas moved, because the volume of the gas as well as the draft increases directly with the increase of temperature, while the resistance to flow increases as the square of the velocity. It seems, then, that to increase the stack capacity of an existing boiler plant, an addition to the stack height is necessary. This additional height can usually be obtained without serious difficulty.

If it were desired to increase the output of this size of boiler by 20 per cent, we find from the table that a 48-in. stack 150 ft. high would be required. The table also shows that a 54-in. x 90-ft. stack will permit the same boiler output to be developed. Now, would this size stack develop the higher rating with 3,480-sq.ft. boiler? No, it would not, because the height would not be sufficient to overcome the increased resistance incident to the increased capacity. Increasing the diameter of the stack will have only the effect of reducing the resistance in the stack, which is a small part of the total. The areas of the gas passages in the boiler setting have not been changed, and as the pressure required to move the gases varies about as the square of the velocity, we find that to develop capacities in excess of the nominal, the height of the chimney would have to be increased in the order of the square of the rating. For example, to develop 150 per cent rating the height of stack would be $1.5^2 = 2.25$ times, and for 200 per cent rating $2^2 = 4$ times the height of stack necessary to develop the rated capacity. This is only approximately true, as the stack temperature will increase with the boiler rating, thus tending to increase the draft available from a chimney of given height. Also the velocity of the gas does not increase directly with the rating.

Forecasting Water Suppply

For Hydro Developments

By A. Streiff

Jackson, Michigan, Office
Stevens & Wood, New York City

SINCE the relations mentioned in the previous article do exist, we can no longer proceed on the basis of a chance sequence of river flow. The solar cycle can be estimated in an approximate manner, years ahead, and the run-off cycle in many localities is therefore also subjected to estimate a long time in advance.

Let us examine some of the facts, chosen at random, which refute the conception of stream flow as a fortuitous occurrence. Fig. 1 gives the elevations of the Great Salt Lake in Utah, of Lake George in New South Wales, and a graph of the Wolf numbers. It is noted that the Wolf numbers oscillate in approximately eleven-year swings around a varying mean shown in dotted lines. It is this dotted line which agrees closely with Professor Bruckner's curves. A similarity of this cycle with the median line drawn through the lake elevations can be noted. At closer inspection it is seen that the lake levels also vary above and below the Bruckner cycle in an apparently irregular manner, but often recognizable as two fluctuations for each eleven-year cycle.

In the previous article, April 16 number, variations in climate, temperature and rainfall were discussed. This study is carried into practice here and the relation between the solar cycle and rainfall is compared. Instances of predicting stream flow two years ahead for power development are cited.

It can be seen that the Great Salt Lake fluctuations are opposite in phase to the eleven-year cycle in the Wolf numbers, whereas for Lake George they are in phase with the eleven-year cycle. The relation is so faithful that, when the graph was made in 1924, it could safely be expected that the level of the Great Salt Lake would drop during the next four years. By courtesy of the United States Geological Survey the records to date were obtained and the expectation fully verified. In the same manner it may well be expected that the lake will rise during the next four years or so. It may also be expected that the long swing of the Bruckner cycle will cause in 1945 as high levels as prevailed in the early seventies, thereby increasing the lake area by some 400 square miles. The importance of this expectation for riparian owners is obvious.

The monthly hydrograph of the Muskegon River in Michigan is shown in Fig. 2. It will be seen that the maxima of run-off nearly coincide with both maxima and minima of the Wolf numbers, shown at the top of the figure. The maxima of run-off precedes the maxima and minima of the Wolf numbers by one year. The agreement appears to be a faithful one, as it may be seen that when the Wolf maxima and minima are close together, the stream-flow maxima also crowd together and vice-versa. The same agreement prevails in the records of the Ausable and the Manistee Rivers, also in the southern peninsula of Michigan.

Taking the Winnipeg River, a watershed about 600 miles northwest of southern Michigan, we see in Fig. 3 the same characteristic present as in Fig. 2, but the proportions changed somewhat. Here a high peak occurs one year previous to the maximum of the Wolf numbers, and the secondary maximum of stream flow occurring during the minimum of the Wolf numbers has reduced in importance. Again, a different picture presents itself if we move eastward to Pennsylvania and still farther east to Maine. It is then found that one of the maxima in run-off has disappeared, and only three maxima in run-off occur during two sun-spot cycles, but the missing maximum is then characterized by large floods during otherwise dry years.

Here we have, therefore, a double sun-spot cycle, plainly evident in our run-off data. This double cycle is still, though imperfectly, discernible in the lake cycles of Fig. 1. It might now be asked whether this cycle in run-off is a mere accident, or whether perhaps it might be traced elsewhere. Let us take at random records from other regions. Fig. 4 gives a part of the record of the high stages of the Nile, from the old Turkish records, recently published by the Egyptian historian, Omar Toussoun Pascha, in the "Memoires de l'Institut d'Egypte." It may be seen that here again we have the double sun-spot cycle as clearly shown as in the Muskegon River record.

A rainfall record, Fig. 5, for Rochester, N. Y., also shows the double sun-spot cycle. The rainfall record

of the ancient university city of Padua, Italy, boasting of one of the longest rainfall records in existence, again shows the same double sun-spot cycle, Fig. 6.

It might now be asked what longer records would show regarding this cycle. The Nile record, 1,400 years long, unfortunately is only fragmentary after the Fifteenth Century. It is complete and unbroken only for the first 800 years of the Hegira, during which time the records of the sun-spot cycle in turn are only fragmentary, as they are based on historical evidence of intense Aurora.

The records of the sun-spot maxima are fairly accurate up to the beginning of the Sixteenth Century, having been carefully compiled by the late Professor Wolf and published in the "Astronomische Nachrichten." Hence we must look for a record that is unbroken from the beginning of the Sixteenth Century to date, if we desire to compare with the sun-spot cycle.

Such a record has been made by Professor Douglass, of the University of Arizona, by measuring the yearly growth rings of the Sequoia, the giant redwood of California. It appears that for certain locations the amount of moisture is reflected in the width of these growth rings, that the tree is in a measure an index for rainfall through the ages. Taking the Douglass record, which is some 3,000 years in length, and selecting the last portion from the beginning of the Sixteenth Century to date, the double sun-spot cycle can easily be isolated from that record, Fig. 7. Above this record the years of sun-spot maxima according to Professor Wolf are given. Thirty sun-spot cycles may be counted, whereas the Sequoia chart shows 57 cycles; hence out of 60 only three cycles failed to develop. Considering that the Sequoia growth rings are less than a millimeter in width and that many influences change the width of these rings besides moisture, this record may serve as a confirmation of the previously mentioned examples. Remarkable it is that in the short cycle 1685-93 the growth cycles are also close together; in the long cycle 1660-75 the growth cycles are also far apart. The growth cycles with high amplitude coincide with a high mean of the sun-spot number.

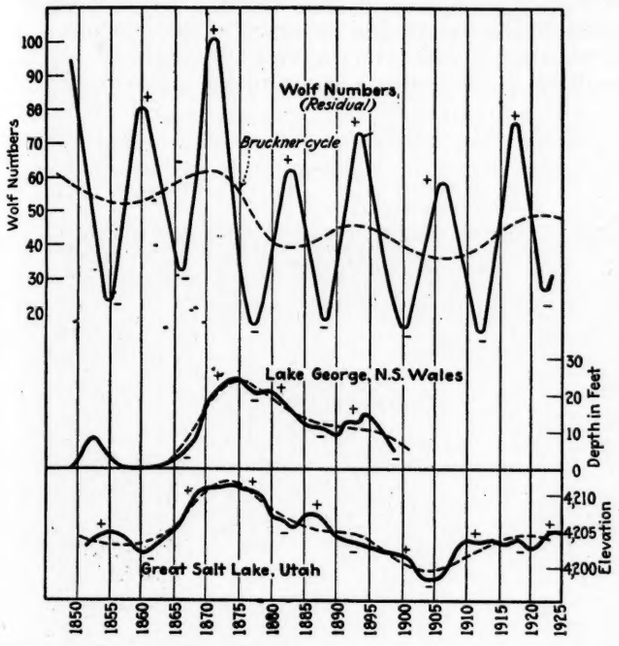


Fig. 1 (Above) — Lower curves show variation in lake levels, and the top curve indicates the eleven-year cycle of the sun-spots

Wolf numbers are an index, introduced by the late Professor Wolf, to measure the relative abundance of the sun spots.

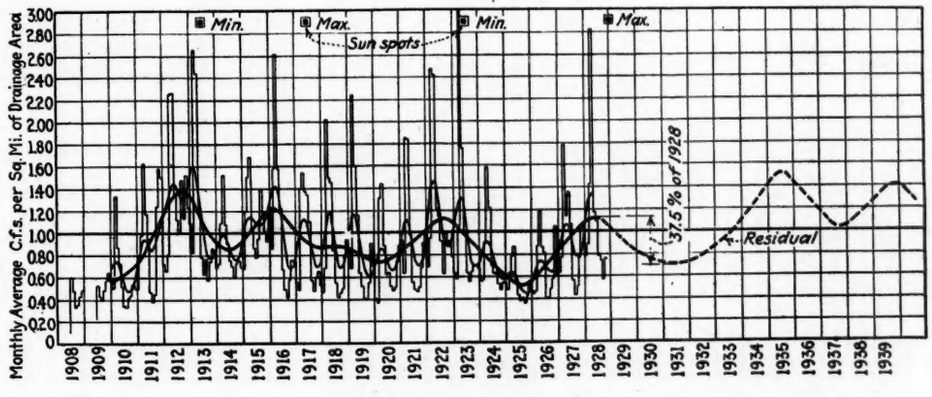


Fig. 2 (Right) — Monthly hydrograph of the Muskegon River in Michigan

Analyzing Run-Off Records

These examples are but a few out of a great many that may be compiled to show the relations referred to. Run-off records must be analyzed in the light of these relations, which do exist and restrict the possibilities for the immediate future to well-defined probabilities within rather narrow limits. Fig. 8 shows the mass flow curves of the Croton River, New York City water supply, and of the Tennessee River, the two longest flow records in the United States. It may be seen that such long records may be subdivided into epochs of distinctly higher and lower flow and that the run-off is a definite function of time. The next fifteen-year average is expected to continue dry on the Tennessee watershed, and the Croton water supply of New York City is expected to continue aboundant for the next fifteen years.

Such correlations are of utmost importance for the estimate of future hydro-electric power. The Muskegon record shows that in the year 1931 there will be a deficiency in hydro-electric output, if no further dams are built until then, which for the whole state will total some 300,000,000 kw.-hr. This decrease in power is equivalent to subtracting the combined output of some half-dozen hydro-electric plants each of which cost about $2,000,000 to build!

Based on the same relation the writer stated in the *Proceedings of the American Society of Civil Engineers* of November, 1926, that the next two years would see a higher run-off in Michigan. This actually happened; 1927 and 1928 were respectively 21 and 36 per cent higher-flow years on the Ausable River than 1926; on the Manistee River respectively 11.5 to 25 per cent higher. The flow of the Manistee River, estimated for 1928 and published in the *Monthly Weather Review* of March, 1928, checked within 5 per cent with the estimate. The flow of the Winnipeg River was estimated to be, for 1928, 55 per cent of the flow during 1927. It actually

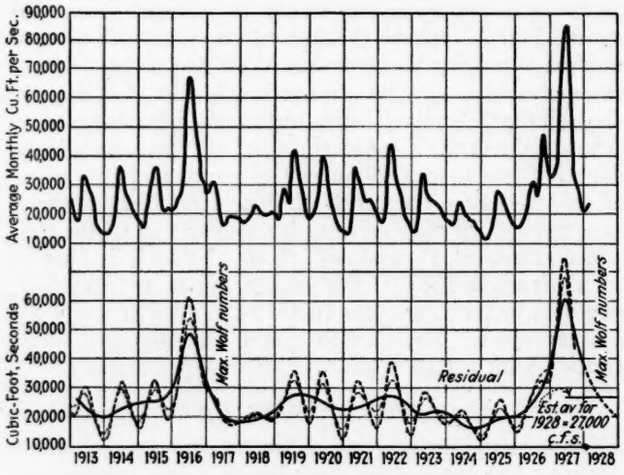

Average Monthly Cu. Ft. per Sec.
Cubic-Foot Seconds
Max. Wolf numbers
Residual
Est. av for 1928 = 27,000 c.f.s.
Max. Wolf numbers
1913 1914 1915 1916 1917 1918 1919 1920 1921 1922 1923 1924 1925 1926 1927 1928

Fig. 3—Hydrograph of Winnipeg River at Slave Falls

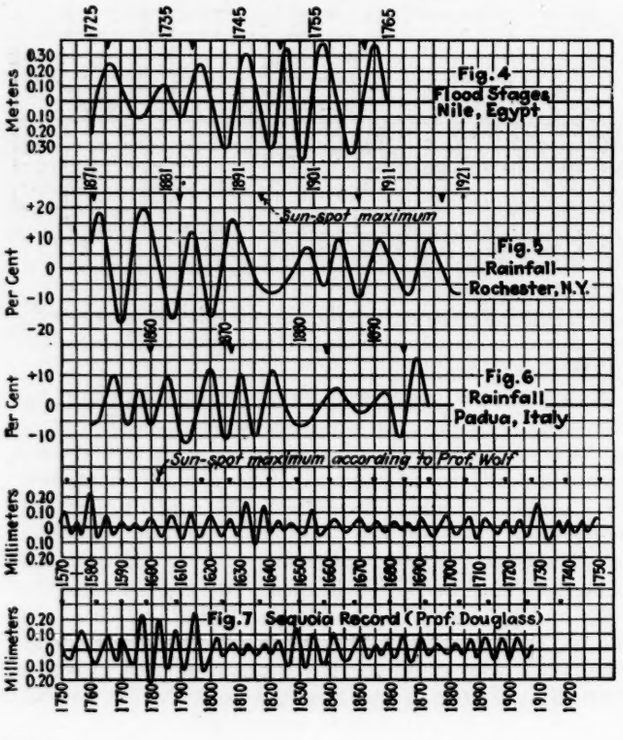
Drainage area 53,000 square miles.

was determined by the Dominion Bureau of Reclamation and Power to be 60 per cent of 1927. A copy of the 1928 estimate had been sent for purposes of verification to Dr. A. J. Henry, of the United States Weather Bureau, Washington, D. C.

In planning the extensions of their electric power service, public utilities can now with greater certainty analyze the fluctuations in hydro-electric power of their systems, which, as we have seen, run into imposing totals. Progressive utility management now requires the establishment of a power-survey bureau, which not only scrutinizes statistics of increased demand, but also investigates the trend of hydro-electric power output, needed to insure maximum returns on capital investment. The coal consumption for next year can be estimated quantitatively within narrow limits, and definite contracts for the fuel requirement can be made at the opportune moment.

As previously stated, researches in periodicity of stream flow constitute a new and special chapter of hydrology. As in many other branches of his art, in this field, too, does the engineer penetrate farther than the scientist cares to go. For instance, mathematical hydrodynamics is unable to solve some of the simplest hydraulic problems, but the engineer builds turbines having over 90 per cent efficiency. The flow of steam through nozzles and turbine rotors can only by approximation be analyzed mathematically, but engineers build huge steam turbines of high efficiency. Scientists are still differing on the question of relationship between Wolf numbers and meteorological data, but the hydraulic engineer, finding fresh evidence of that relation in the realm of stream flow, hitherto untouched by scientific research, does not hesitate to apply his findings to the pressing needs of hydro-electric practice and to the management of public-utility properties.

Figs. 4 to 7—Relation of rainfall and run-off cycles to the maxima of sun-spots



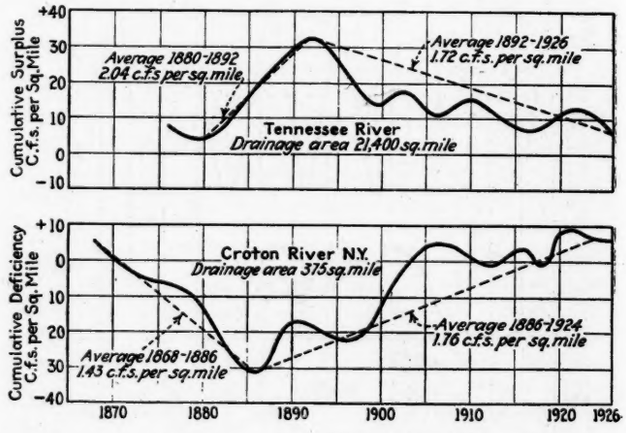

Cumulative Surplus C.f.s. per Sq. Mile
Average 1880-1892 2.04 c.f.s per sq. mile
Average 1892-1926 1.72 c.f.s. per sq. mile
Tennessee River Drainage area 21,400 sq. mile
Cumulative Deficiency C.f.s. per Sq. Mile
Croton River N.Y. Drainage area 375 sq. mile
Average 1868-1886 1.43 c.f.s. per sq. mile
Average 1886-1924 1.76 c.f.s. per sq. mile
1870 1880 1890 1900 1910 1920 1926

Fig. 8—Mass curves of run-off records for the Croton River, N. Y., and the Tennessee River

Why Alternating-Current Contactor Coils Burn Out

THERE is a great difference in the operation of direct-current and alternating-current contactors. Overlooking this fact has been the cause of many burnouts of the coils on alternating-current-motor control equipment. In a direct-current magnetic contactor coil the current is the same when the contactor is open as when it is closed. On alternating-current contactors the current in the coil, when the contactor is open, is much greater than when the armature is in the closed position.

With alternating current the current in the coil is limited by the resistance of the coil and its inductance. When a contactor is open, there is a long air gap in the magnetic circuit and the magnetic flux is much less for a given number of ampere turns than when the magnetic circuit is completed, by the contactor closing. Consequently, the inductance in the coil will be less and the current higher when the contactor is open than when it is closed. If, owing to misadjustment or other causes, an alternating-current contactor does not close when the coil is energized, the coil will roast out in a short time if left in circuit.

Diesel Engines Can Be Operated at High Altitudes

By J. J. McDOUGALL

THE question of operating oil engines at high altitudes is being much discussed at present, and many seem to think it difficult of solution. This is erroneous.

From experience with Diesel engines operating at altitudes from 6,500 to 8,500 ft. above sea-level, I feel that there should be no difficulty in obtaining full rating with any well designed four-stroke-cycle engine, provided the correct adjustments are used; these adjustments will depend on the service conditions.

If the average load is about 80 per cent rating and full rating is required only for a few minutes, the engine should develop it easily and on a momentary load should be able to carry 10 per cent over its sea-level

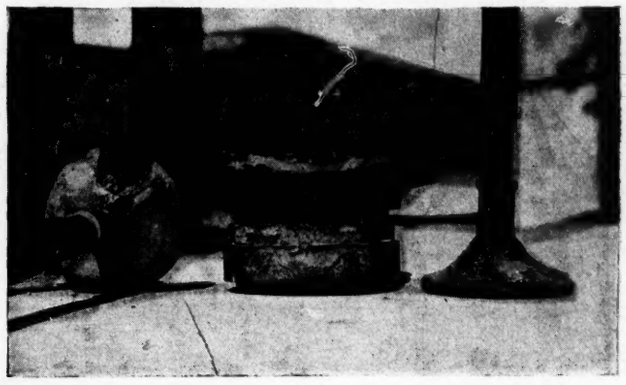
A piston head burned out by reason of high temperatures

rating without requiring any more than the usual fuel-valve adjustments to give satisfactory combustion. The pistons, valves and cooling system must be kept in first-class condition and the adjustments watched closer than on a normally rated engine for the altitude.

If full rating must be developed continuously, with the usual 25 per cent overload capacity, the engine must be supercharged; that is, the cylinders must be charged with compressed air at a pressure and temperature that will bring the weight and temperature of the air in the cylinder up to what it would be at sea-level.

All that is necessary is to install a small high-speed blower, driven by the engine or a motor. No great amount of power will be required, nor is all this power lost, for the engine no longer loses power on the suction stroke, which is considerable in some engines. This blower should be connected to the header supplying the inlet valves in such a manner that it can be quickly cut out to permit the engine to draw air directly from the outside on light loads. The blower should not be used as a ventilating machine, to take all the hottest and foulest gases from the engine room, but should be connected up to the coldest and cleanest air available. The capacity of the blower at, say, three pounds gage should be the combined piston displacement of all the cylinders plus 10 per cent.

If the cylinder clearance is the same as it was at sea-level, no excessive combustion pressures will result from the supercharge, but if it has been reduced to give about 500 lb. per sq.in. at the existing altitude, the clearance



Improper supercharging caused these valve failures

space should be increased, otherwise dangerous pressures may be reached, particularly on the overload, which nearly always results in considerable bearing trouble. When properly installed and operated, the supercharged engine gives far less trouble on heavy loads than an engine developing overload without supercharging, but if the supercharging is improperly done, the results obtained will be worse than a non-supercharged engine, and the damage soon costs more than another engine.

The photographs show some of the effects of improper supercharging. In this case the supercharge pressure was too low and the temperature too high, resulting in a

Engine's breakage due to supercharging

decrease in the required air charge of about 30 per cent. In attempts to develop the rating, the combustion pressure was run up to 700 lb. per sq.in. instead of the normal 525 lb. Failures such as these should not be charged against the Diesel engine, for they rarely occur when the engine is properly designed for its guaranteed rating. Continuous overload will burn up the best engine, but if properly supercharged this load can be developed without trouble; if the supercharging is not done right, the results will be far worse than with a non-supercharged engine.

A One-Man Plant

Placing the machinery and freezing tank in one room enables the engineer to run the entire plant

SO FIRMLY convinced was A. A. Murdock that an oil-engine-driven ice plant did not need a man in the engine room at all times, that in this new Charlotte, North Carolina, plant, the engineer will attend to the ice pulling and other plant duties.

The old-time belief that only large ice plants could make a profit has been definitely dispelled. In the South as elsewhere new plants are in the main of small capacities, so situated that the distribution costs are far below those that existed when ice wagons from a single large plant covered an entire city.

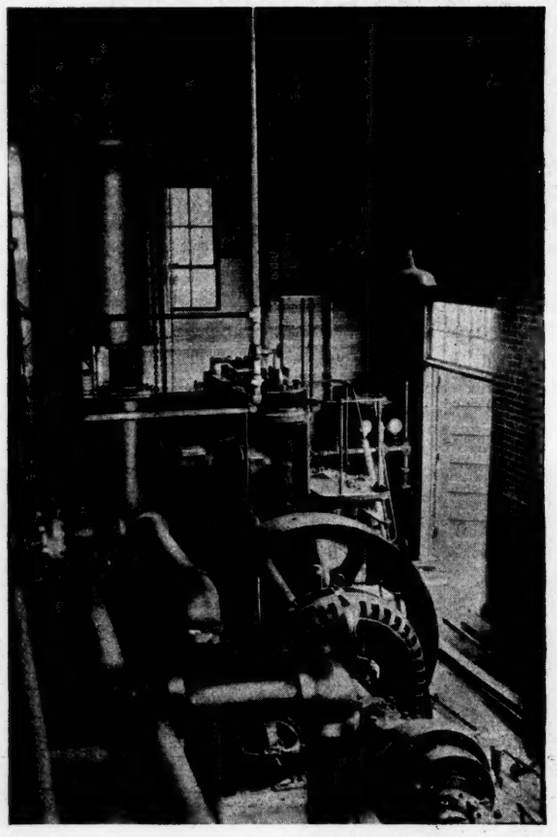
Small local ice plants must necessarily be placed close to their consumption center, which was objectionable if coal-fired boilers were used. Even where electric rates were not unduly low, the lack of smoke promoted the installation of electrically driven machinery.

While the advantages of Diesel engines are generally conceded, some have felt that there must necessarily be objectionable exhaust gas. The owner of the Charlotte plant had discovered from experiences with another oil-engine plant that the exhaust could be made noiseless and free from smoke by the installation of proper equipment.

Consequently, Diesel drive was chosen. Even though electric rates in North Carolina are low, the Diesel is expected to generate power at a still lower cost, based on experiences with Diesel- and electric-driven ice plants in Durham and Raleigh.

The Charlotte plant is rated at 30 tons of ice-making capacity and is housed in a red brick one-story structure. As shown in the illustrations, alongside the ice tank is placed the machine room at the ground level, so that the ice puller has the entire machine equipment immediately within his vision.

A 120-hp. two-cylinder two-stroke-cycle crankcase scavenging Diesel operating at 257 r.p.m. carries a 37-kva. alternator on its extended shaft. Beyond the outboard bearing a two-cylinder single-acting compressor is connected through a solid coupling.



A view of the machine room

Cooling water for the engine is taken from the ammonia-condenser sump by a two-inch motor-driven centrifugal pump. The warm water leaving the jackets flows into the ice-can dipping tank.

Fuel oil, which costs 6.7c. per gal., is received in tank cars and flows by gravity to a 12,000-gal. above-ground steel tank placed outside the building. From this point it is lifted by the engine's fuel pump and delivered to the fuel-injection pump, which is mounted on one end of the engine frame. The exhaust gas from the cylinders escapes into the usual exhaust pipe. To avoid complaints of noise, from neighborhoods, a Maxim silencer is placed immediately above the exhaust port, as shown in one of the illustrations, and as a further precaution a water line is connected to the base of the silencer.

The twin-cylinder ammonia compressor discharges into a single vertical shell-and-tube condenser at one corner of the machine room. The receiver is alongside the can tank and is provided with a purger. The condenser cooling water is picked up from a concrete sump below the condenser by one of two 250-gal. 40-ft. head motor-driven centrifugal pumps. The pump discharge lines are Y-connected with the straight-run line passing the water to two spray-nozzle clusters on the roof. The water, after being cooled by the spraying, drops to the roof and flows into a catch basin immediately above the condenser.

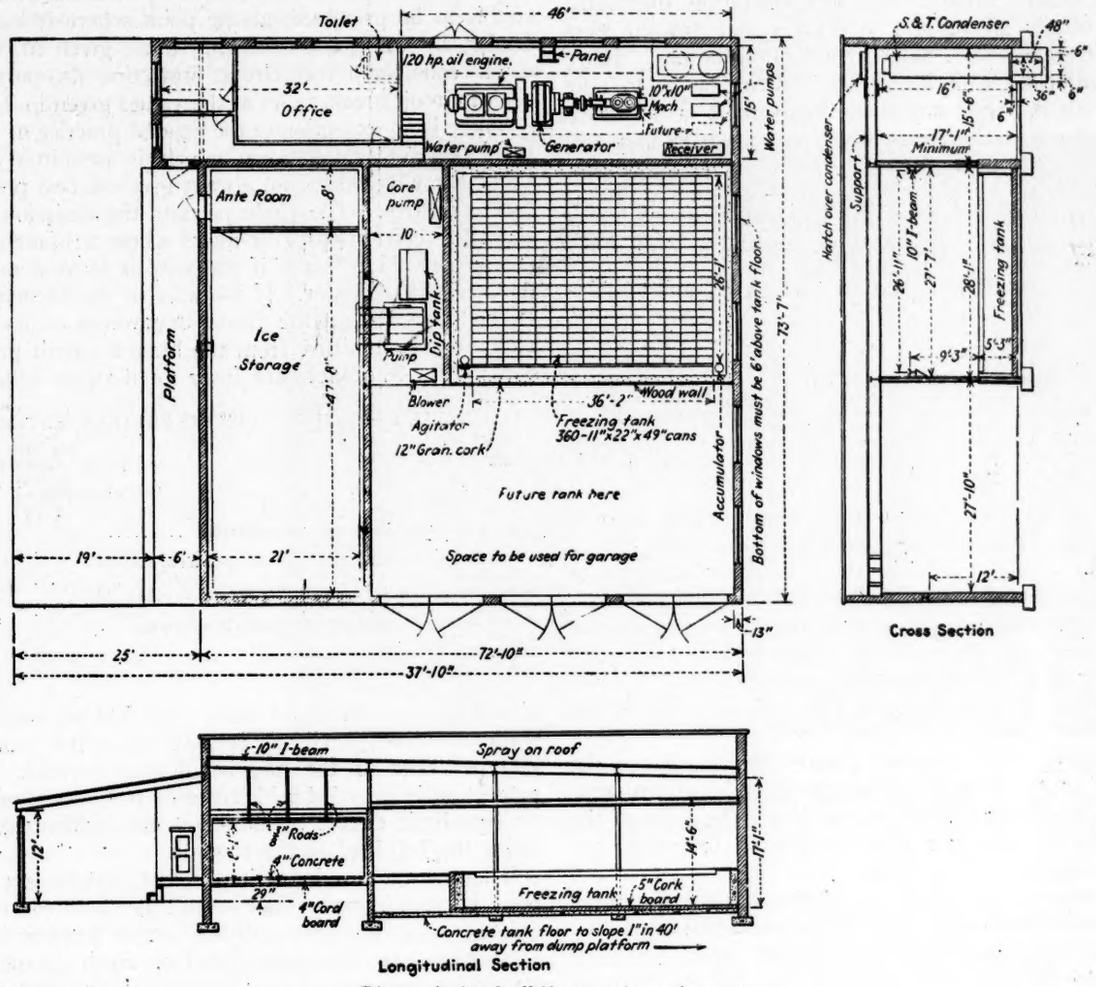
One circulating pump receives current from the engine-driven generator, while the second unit, a stand-by, is connected through the usual control to outside electric lines. Both the suction and discharge lines of the pumps

have blanked connections, as additional plant capacity will be installed when the ice market is built up.

The ammonia liquid line leads to a float control which maintains a constant liquid level in the ammonia accumulator. This eliminates all manual adjustment of the expansion valve. The tank evaporating apparatus consists of horizontal suction and discharge headers running along one side of the tank and connected by a

the fuel and lubricating oil costs will not exceed 40c. per ton, and in view of the small amount of labor in the plant the total manufacturing costs will be low as compared to plants built 10 years ago.

The entire layout has been made with a view to keeping the maintenance to a minimum. Ample room is left about each piece of apparatus, and each pump can be shut down without disturbing the functioning of the rest



Plan of the building and equipment

series of vertical herringbone pipes, all welded together at the factory. This coil is inclosed in a steel compartment through which the brine is forced by a vertical agitator. The ice tank is of all-steel construction and is insulated by twelve inches of granulated cork on the sides and rests upon five inches of cork block.

The agitation system is of York design, using air at three pounds pressure from a motor-driven blower, which takes its suction from beneath the tank cover.

Although the city water is clean and sediment free, it is treated with alum and filtered through quartz sand. Can coils are sucked, for which purpose a one-inch centrifugal pump with automatic primer is used.

A one-ton electric hoist enables the operator to harvest the ice in gangs of four cans. After being dipped, the ice is dumped into a chute and sent into the storage room, which is maintained below 32 deg. F. by a set of two-inch brine wall coils. The brine is pumped from the ice tank.

Athough the plant has not been operating long enough to reveal what operating costs will be, it is expected that

of the equipment. The engine can be operated to supply current to the auxiliaries with the compressor idle by unbolting the flexible coupling. In case of engine trouble the tank agitation can be carried by purchased current.

PRINCIPAL EQUIPMENT A. A. MURDOCK ICE PLANT

Compressor	30-ton two-cylinder inclosed type
Make	York Ice Machinery Corp.
Engine	Two-stroke-cycle 120-hp. Diesel
Make	Fairbanks Morse & Co.
Generator	37-kva. 257 r.p.m., F.M. & Co. alternator
Exciter	5-kva., driven by a Morris silent chain from engine shaft
Engine water pump	2-in. F. M. & Co. centrifugal
Silencer	Maxim Silencer Co.
Condenser	York Shell-and-Tube
Condenser water pumps	Two 2-in. 250-gal. Dayton-Dowd centrifugal
Spray nozzles	Spray Engineering Co.
Evaporating system	York
Agitator system	York
Air blower	Allen & Bellmyer 3-stage 3,600-r.p.m. blower, d.c. to 3-hp. Star Elec. Works motor
Core pump	1-in. La Bour centrifugal d.c. to 1-hp. 1,800 r.p.m. Howells Motor
Ice hoist	3-ton Shepard Niles Crane & Hoist Corp.
Brine pump	1-in. Dayton-Dowd centrifugal
Water filter	York quartz

Control Equipment Requires Protection

By C. B. Bradish

Industrial Control Engineering Department, General Electric Company

MODERN industrial control devices are designed to withstand satisfactorily any operating overloads, which include all running overloads and any currents up to the stalled rotor value of induction motors. There is not sufficient capacity in the control device to take care of short-circuit currents, therefore it is necessary to have fuses or circuit-breakers located where they will open before the short-circuit current destroys the control device.

Ordinarily, the fuses in the motor branch circuit at the feeder will protect the control device against short

TABLE I—MAXIMUM RATING OF BRANCH CIRCUIT FUSE

Type of Motor	Per Cent Full-Load Motor Current
Single-phase, repulsion or split-phase starting	300
Squirrel-cage, full-voltage starting	300
Squirrel-cage, reduced-voltage starting (not more than 30 amperes)	250
High-reactance squirrel-cage (not more than 30 amperes)	250
Squirrel-cage, reduced-voltage starting (more than 30 amperes)	200
High-reactance squirrel-cage (more than 30 amperes)	200
Slip-ring a.c. and d.c.	150

circuit. There are cases where the motor branch circuits are short and fuses are omitted from them, short-circuit protection being provided by the breaker or fuses in the feeder. The size of the feeder fuses or breakers may be such that they will not trip on currents too great for the control device at the motor. In such cases it is necessary to provide just ahead of the controller a set of fuses or a circuit breaker to protect it against short-circuit currents.

This matter has assumed greater importance in the last few years, because of the introduction of temperature overload relays which ordinarily are the parts of the control device that are least capable of carrying very heavy currents.

It is essential, therefore, to protect control apparatus from short circuits and other similar excessive overloads. Because of the inherent limited thermal capacity of control apparatus, it is also essential that the short-circuit protective device remove the overload as quickly as possible. For circuits of 600 volts and less fuses are satisfactory, within their limits of 600-ampere current-carrying capacity. They are practically instantaneous and will interrupt 10,000 amperes without trouble. If merely considered on the basis of insurance against trouble, fuses are economically a good investment. Their replacement is a fraction of the cost necessary to repair a damaged controller, without considering the loss of production caused by a shutdown for repairs.

One of the objections to fuses has been their deterioration in service and consequent opening of the circuit unnecessarily. Probably most of these complaints are on installations where the fuses are carrying very close to their rated current. When used as protection to control, they would ordinarily be considerably larger than this; that is, three or four times the rating of the control. In this case there is but little heating at the clips and the life is long.

When using oil circuit-breakers as short-circuit protection, it is preferable to use an instantaneous breaker set at seven times, rather than a time-limit breaker set at four times normal load. There is a definite minimum time lag of approximately one-half second with the latter type, irrespective of current value. This time lag, under extreme conditions, may be too long to prevent some damage to the control.

The 1928 National Electrical Code permits the use of wire in branch circuits to motor and control selected on the basis of 125 per cent of the full-load motor current. The overload device in the controller is to be set at not over 125 per cent. With few exceptions the branch circuit is to be protected, at the point where it leaves the feeder, by fuses not exceeding those given in Table I.

The code for branch circuit protection also permits the use of circuit breakers set at the values given in Table II.

There is an exception to the general practice of making branch-circuit installations, which is permitted by the Code, but which does not always give the best protection to the control. The Code permits the omission of the branch circuit fuses or breakers where a branch circuit is not over 25 ft. long, if the wire is at least one-third the size of the feeder. If the wire of the branch circuit is the same size as the feeder regardless of its length, fuses may be omitted from the branch circuit provided, back on the line, there are fuses rated at, or a time-limit

TABLE II—MAXIMUM CIRCUIT-BREAKER SETTING

Type of Motor	Per Cent Full-Load Motor Current: Instantaneous Type	Per Cent Full-Load Motor Current: Time-Limit Type
Single-phase, repulsion or split-phase starting	...	250
Squirrel-cage, full-voltage starting	....	250
Squirrel-cage, reduced-voltage starting (not more than 30 amperes)	...	200
Squirrel-cage, reduced-voltage starting (more than 30 amperes)	...	200
High-reactance squirrel-cage (more than 30 amperes)	...	200
Slip-ring	...	150
Direct-current (not more than 50 hp.)	250	150
Direct-current (more than 50 hp.)	175	150

circuit breaker set at not more than 500 per cent, or an instantaneous-type circuit breaker set at not more than 700 per cent of the motor full-load current. Better protection is afforded with fuses of not over four times, or time-limit circuit breakers set not higher than four times the full-load motor current.

There are a few induction motors that have a stalled rotor current of more than seven times full-load current. Of necessity, an instantaneous circuit breaker in such service must be set above this value. Such a combination should be given special consideration. Some types of control will be properly protected with higher settings of the circuit breaker and some will not. Seven times setting is a safe general recommendation.

Putting Sewerage Gas to Work

Sanitary sewerage disposal plants give off a lot of gas that is usually wasted. Although the burning of this gas in gas engines has been tried out successfully in England, Charlotte, North Carolina, is the first American city to develop power from such gas.

Laws of various states require the installation of sanitary disposal plants, and as the operating costs are considerable, the sewerage-gas engine offers a means of reducing the yearly expense by over 10 per cent.

An article on the Charlotte plant will appear in *Power* of May 7.

Waste-Heat Boilers at Timken Plant

THE Timken Steel & Tube Company has recently installed a waste utilization plant that has several interesting features. The plant proper consists of two five-drum Stirling-type waste-heat boilers of 6,090 sq.ft. each, with feed-water heater and superheaters, which furnish steam at 150 lb. pressure, 100 deg. superheat, for various purposes such as atomizing the fuel oil for the open-hearth furnace burners, for various processes and machines in the mill, and for the supply of the building heating system.

Upper section of the waste-heat boilers from the charging flow. One of the furnace stacks is shown in the background

The general arrangement and operation of the equipment is substantially as follows: The two boilers are located side by side, between the furnace stacks and are inclosed in brick shells that form part of the flue systems which convey the waste gases from the furnace checkerwork to the stacks. Each main flue is provided with two branches below the boiler foundations, which receive the waste gases directly from the furnaces; one leads directly to the stacks and the other to the boiler shells. This results in a minimum gas travel from the furnace checker chambers to the boilers. The flow of gas is controlled by individual motor-operated, water-cooled dampers to the stack and plain motor-operated slide dampers to the boilers, an arrangement that permits the operation of any combination of boilers and stacks that circumstances may determine.

Each boiler has a 65-hp. steam-turbine-driven induced-draft fan in the duct leading from the boiler shell to the stack, and having a capacity of 130,000 lb. of gas per hour at 500 deg. F. against 4½ in. static pressure. The gas makes three passes through the boiler shell, the superheater tubes being in the first pass. It leaves the furnace checker chambers at about 1,200 deg. F.

Both boilers are supplied with feed water from a deaërating feed-water heater. Two multi-stage centrifugal feed pumps are provided, one driven by an electric motor and the other by a steam turbine. The latter is used at all times except when the boilers have been taken out of service, when the motor-driven pump is used until they are up to pressure. The turbines that drive the induced-draft fans are supplied with steam at 150 lb. and exhaust into the feed-water heater. The latter is of a standard deaërating type, the heat being supplied by the exhaust steam from the turbines which drive the boiler fans. Each boiler has an automatic feed-water regulator.

As a result of this arrangement the amount of steam necessary for heating and process work is supplied at a cost that is quite economical when compared with that of fuel-fired boilers for the same purpose. The system is flexible and steam can be supplied in just the quantities necessary to meet varying demands without involving waste.

Practical Test for Turbine Oils in Force-Feed Systems

By H. L. Kauffman

AT THE United States Navy Engineering Experiment Station, Annapolis, in examining turbine and similar oils used in force-feed systems, tests are made on the station's friction machine to determine the relative friction under varying conditions of speed, bearing-cap pressures and temperatures.

A test journal 6 in. long by $3\frac{13}{16}$ in. in diameter is lubricated by force feed. The journal is revolved at a speed of 2,000 r.p.m. and is maintained under a bearing pressure of 150 lb. per sq.in. During the test the circulating oil is not cooled but is allowed to attain any temperature it may. The lubricating oil is fed to the upper on-side of the bearing at a pressure of 15 lb. gage and is continuously circulated from the oil reservoir to the test journal and back to the oil reservoir. The oil is tested for a period of 100 hours, readings are taken hourly of the temperatures of the bearings and circulating oil, and hourly calculations are made of the coefficient of friction. The lubricating oil is examined after the test in order to determine its condition and the nature of the changes that take place in the oil during the practical test.

Chart for Determining Loss by Combustible in Refuse*

By C. A. Kulmann
Pelton Water Wheel Company

THIS nomograph gives a quick and accurate method of finding the heat loss due to combustible lost in the refuse and is based upon the usual equation

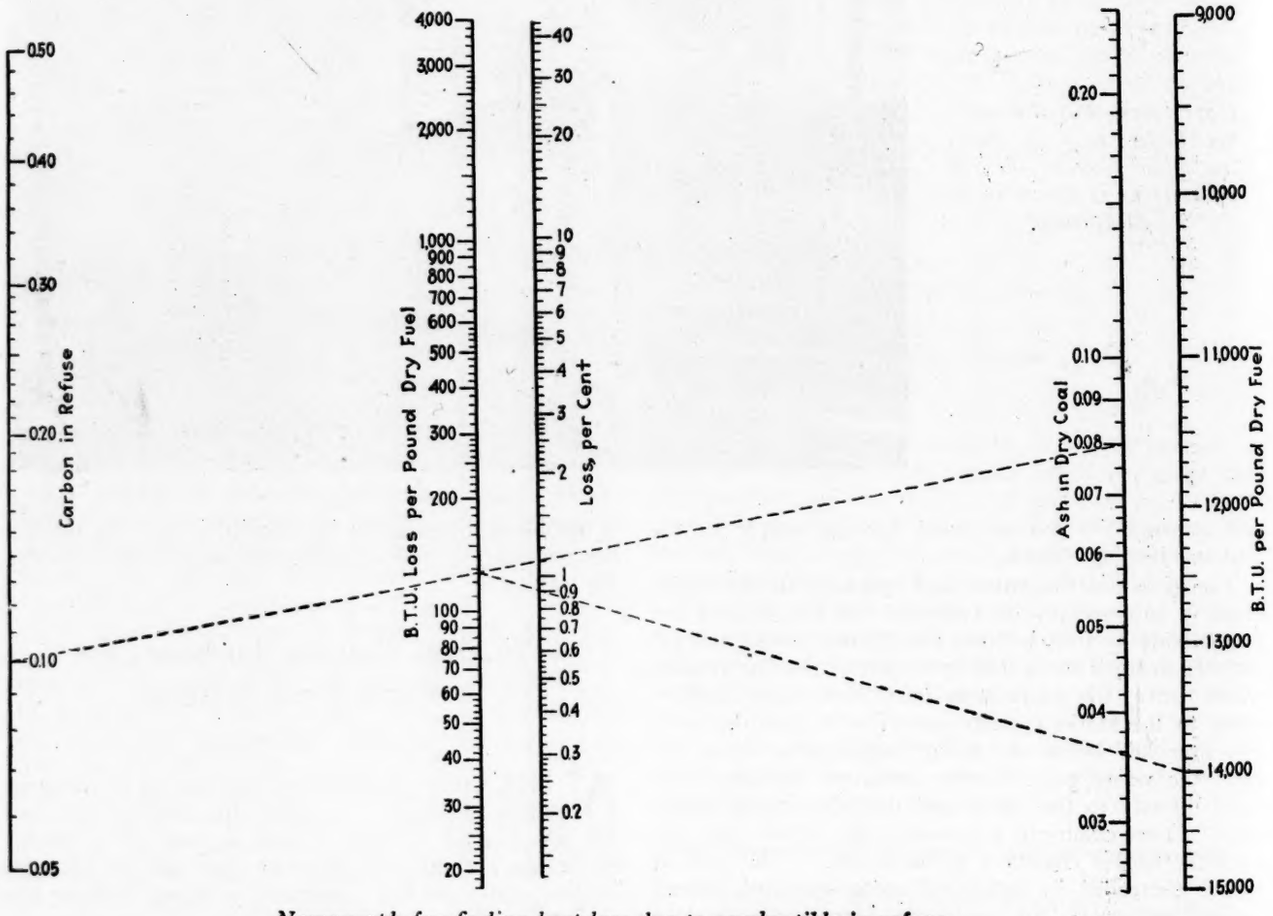
$$L = 14{,}600 \times \frac{AC}{(1 - C)},$$

where L is the loss in B.t.u. per pound of dry fuel, A is the ash content per pound of dry coal, and C is the carbon content of the refuse.

To use the chart, connect with a straight-edge the proper values on the ash in dry coal and carbon in refuse scales, and read heat loss on the scale marked B.t.u. loss per pound of dry fuel. To find the per cent loss, connect the heat loss just found with the proper value of B.t.u. per pound of dry fuel and read loss in percentage.

The use of this chart is best illustrated by an example. Assume a stoker burning bituminous coal having a heating value of 14,000 B.t.u. and an ash content of 0.08 lb. per pound of dry coal. An analysis of the refuse shows that it contains 0.10 lb. of carbon per pound.

With a straight-edge connect the point 0.08 on the scale marked ash in dry coal with the point 0.10 on the carbon in refuse scale and on the B.t.u. heat-loss scale read 127 B.t.u. To find the percentage of heat loss connect with the straight-edge the point just found and 14,000 B.t.u. on the scale marked B.t.u. per pound of dry fuel. The intersection at 0.9 per cent gives the heat loss in per cent of the heat contained in the dry fuel.



Nomograph for finding heat loss due to combustible in refuse

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Sane Plant Operation Needed

By G. Grow

ENTIRELY too little study is made of power-plant operating procedure in many factory plants.

The plant is designed by a thorough engineer who sees that nothing is omitted that might assist in reducing the cost of power.

After the plant is built, the management too frequently feels that no great skill is needed by the operating force. The efficiency obtained during the initial year's operation gradually decreases until the management awakens to the fact that while the coal bill is mounting higher the power output is decreasing.

The next step is to decide that the plant is too small. New boilers and maybe an extra turbine are installed. With the remodeling the plant efficiency shows an increase which, as months roll by, gradually decreases until the cycle must be repeated.

Such a condition is by no means unusual. For example, in one textile mill the output of the power plant decreased until it was impossible to carry all of the mill. The operating force was firm in its claim tha

the plant needed more boilers and either a new turbine or a new condenser.

Investigation revealed that while, originally, a vacuum of 28 inches was obtained without difficulty, this had gradually decreased until the gage showed not over 16 inches.

Luckily, an outside engineer was employed who made a detailed examination of the plant. He found that the condenser tubes had been allowed to scale up until the tube bore was not over one-half-inch in diameter. The heat transfer, of course, dropped and it was impossible to hold the desired vacuum. The water rate of the turbine rapidly mounted, which, in turn, caused the boilers to prime enough to allow a lot of water to reach the turbine. Corrosion of the turbine blades started and the blades became so bad that the steam rate of the turbine experienced another increase.

The remedy was the thorough scaling of the condenser tubes and the replacement of the first two rows of turbine blades. At once the vacuum went back to normal, the steam rate dropped and the boilers met the steam demands with ease. No new bilers, turbines or condensers were needed and over $10,000 was saved by the re-establishment of sane operating procedure.

Welding the Piping in Heating Systems

By H. O. Westendarp
General Electric Company, Boston, Mass.

THE new high school in Hyde Park, Massachusetts, is completely outfitted with equipment for manual training, domestic science, assembly halls and gymnasium, and accommodates approximately 1,600 pupils.

Electric arc welding was used in installing the steam piping and other heating equipment and the field cutting was done by the oxyacetylene process. There are more than 500 arc-welded joints in the building, and the work was performed with a single gas-engine-driven welding set of the portable type.

The pipe used varied in size from three to ten inches in diameter and was furnished scarfed for welding. The welding procedure was as follows:

1. All pipe hangers were placed in position.
2. Pipe lines were run along the hangers.
3. Welding operator followed along, making the welds.

Where it was necessary for the pipe line to make a right-angle turn, an acetylene torch was used to miter the pipe and a weld was then made.

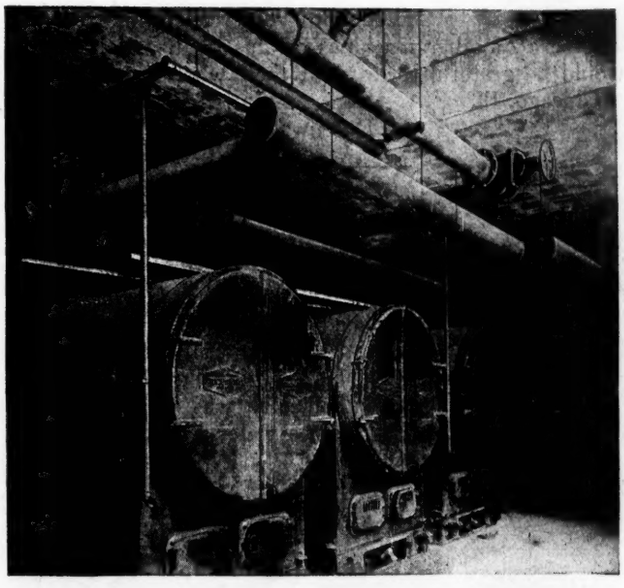
In many places it was advantageous to have a reduction in the size of the pipe line, and to prevent pockets at these points it was necessary to have the bottoms of the two pipe diameters in line. To accomplish this a steel disk was welded into the end of the larger pipe. A hole was cut in the disk, the bottom of the hole being tangent to the inside of the pipe at its lowest point, and the smaller pipe was welded into the hole in the disk.

The manifolds or boiler headers were first held in place by tack-welding. After the proper fits were made, the operator welded the joint up solid.

After the entire line was united in this manner, it was a simple matter for the supervisor to indicate the places for risers and drips in the line. Holes were cut at these points with a gas torch, and couplings were welded in so that the fitters could attach pipes for radiators and other devices.

There were a number of valves in the line, which necessitated using flanges. These were provided by slipping a flange over each end of the pipe and welding the hubs of the flanges to the pipe. These so-called "slip" flanges have a smooth bore the same as the outside diameter of the pipe and were scarfed at the edge of the bore toward the pipe to allow for laying in the welding bead. In most cases they were welded on the pipe side of the flange only, but in some instances it was necessary to weld on both sides of the flange. This was accomplished by slightly overhanging the flange and then welding a bead around in the space at the end of the pipe, thus not interfering with the surface or the gasket that goes between it and the next flange. These slip flanges were found very useful and they effected a considerable saving in cost as against the standard screwed flange when arc welding methods are used.

Cost data show that a conservative price for installing a 6-in. branch tee into a 10-in. pipe line for low-pressure work is $22 where standard thread fittings are used. On this item alone estimates show a reduction in cost of at least 25 per cent when using arc welding. Another substantial saving, often overlooked when figuring a welded pipe line, is in connection with the asbestos covering. This work is much simplified and time is saved, because the welded line presents a smooth outline, whereas the screwed pipe line is irregular because the diameter of the fittings is greater than that of the pipe.



An example of the welding done at the Hyde Park school

After the job was finished, a hydrostatic test was made. In addition to this the system was subjected to a fifteen-pound steam pressure, although the general working pressure on the boilers will be but four or five pounds.

It Is Important to Distribute Coal properly to a stoker, as the stoker should not be held responsible for results if coarse coal is fed to one or two retorts and much finer coal to the neighboring retorts. This fact has been known for a long time and appreciated by some, but ignored by many. There are several different devices on the market that are capable of producing satisfactory distribution of coal in the stoker hopper, and these devices should be used more frequently.

Right Out of the Plant

Museum for Old Motive-Power Relics

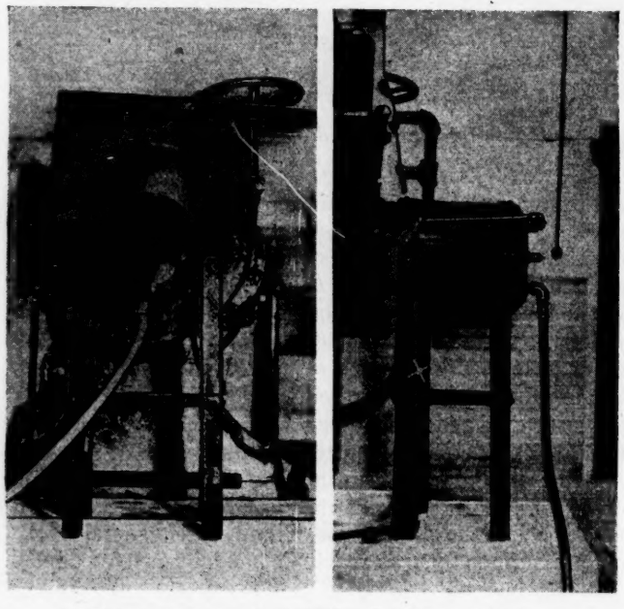
IN A recent number of *Power* the statement was made that many of the old relics of motive power find their way eventually to the junk heap because no institution can be found that will place them on exhibit and house them for the benefit of posterity. One of the purposes of the Rosenwald Industrial Museum is the preservation and exhibition, in working order wherever possible, of epoch-making machines and inventions. If the Newcomen engine that stood for years on the shores of Newark Bay were now in existence, we would gladly make provision for it.

It may well be that some of your readers know of the existence of other machines of this kind, and if so we would be grateful to learn of their whereabouts.

Chicago, Ill. JOHN A. MALONY,
Rosenwald Industrial Museum.

Practical Cooling System for a Prony Brake

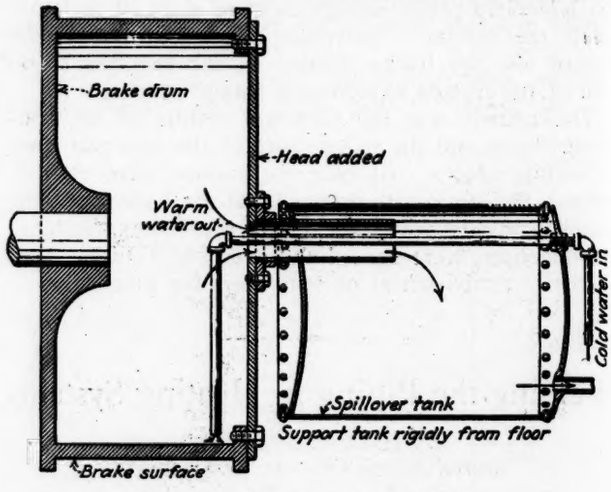
THE electrical laboratories of the University of Colorado have installed an electric testing set consisting of two 600-volt, 30-hp. motors, with the usual controlling apparatus. This set is loaded by means of a large Prony brake. Difficulty was experienced in cooling the Prony brake, since water was thrown from



Arrangement of spillover tank and brake

the drum, making the operation unsatisfactory. What is believed to be an unusual method for circulating the water through the drum, without the usual leakage, was therefore devised. The drum is cooled properly and no throwing of water takes place. The description of this device is as follows:

The open face of the brake drum was fitted with a metal head bolted to the drum and with a rubber gasket between the surfaces. At the center of rotation of this head, a 2-in. hole was bored and a 2-in. pipe flange with gasket and an 8-in. length of pipe was bolted. This pipe served as the outlet pipe for the warm water from the drum. A 12x16-in. round expansion tank was used as a spillover tank. A hole a little larger than the 2-in. outlet pipe was reamed in one end of the tank, 4 in. off



Cross-section of tank and brake

center. The tank was then supported rigidly from the floor, eccentric with the drum, and aligned so the outlet pipe rotated freely within the hole.

The cold-water inlet pipe was made of ½-in. pipe. It was screwed into the tank opposite the outlet pipe and so run through the tank that the outlet pipe would rotate around it. On the inside of the drum this pipe was continued down to the inside surface of the drum in order to bring the cold water directly to the surface to be cooled. The necessary valve and drain hose were supplied to the inlet pipe and spillover tank respectively.

With this device the drum is practically filled with water all the time owing to centrifugal force, as it can get out of the drum at the center of rotation only.

Boulder, Colo. ARTHUR W. HOWARD.

Anchoring and Draining Underground Steam Lines

ACTUAL operation of underground steam lines indicates that some of the details given in the article on page 921 of the Dec. 4 number frequently fail in service.

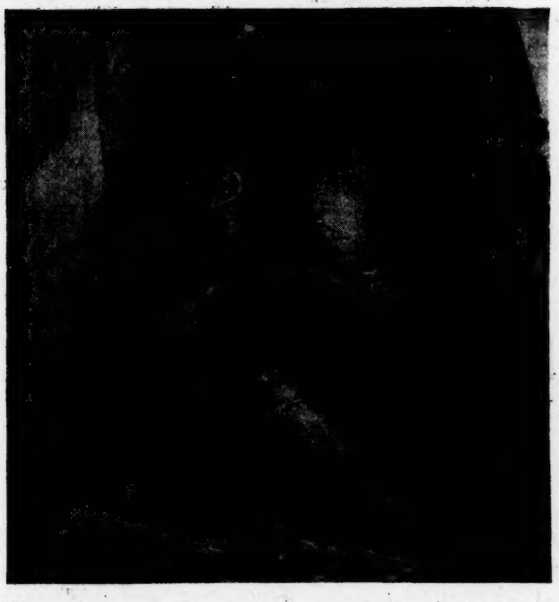
Anchors are often subjected to strains not anticipated in the original design. For instance during a non-heating season a number of the copper-plated steel sleeves in the expansion joints of the returns corroded fast to the packing and follower. At the opening of the heating season expansion caused the anchors, consisting of four bolts set in concrete pedestals and projecting through the bases of the expansion joints, to fail by crushing the concrete and by breaking off. During the following summer these joints were re-

moved, the sleeves forced out in a compression testing machine, and brass sleeves were substituted.

In a sleeve type expansion joint the thrust against the anchor depends largely upon the steam pressure and the diameter of the pipe line. Thus, with an 8-in. diameter pipe carrying 200 lb. pressure the thrust is equal to 58 sq.in. (the area of the pipe) times 200 lb., or 11,600 lb., plus the force required to overcome the friction of the slip member as it is moved by the expanding pipe.

I have had experience with a number of concrete anchor pedestals that have failed in service. These pedestals were cast about a number of reinforcing rods that projected well above the concrete manhole floor. They failed either because the concrete crushed around the holding bolts or pulled loose from the floor.

Taking into account the probable strains to which anchors may be subjected, the clamping device shown by Fig. 2 of Mr. Davidson's article looks inadequate. In fact, inspection of similar clamping devices in anchors



View in manhole showing method of anchoring

shows many failures due to stretching, bending and loosening of bolts.

The figure shows a 10-in. 45-deg. bend one end of which is anchored to a 12-in. channel by two 6x6x½-in. angles, 12 in. long bolted to the channel and welded to the sides of the pipe. Note the angle in contact with the wall on the left end of the channel. It has been installed to prevent the channel from being loosened by the thrust from the right extension of the pipe, which terminates in an expansion joint.

Referring to the arrangement for draining the steam line shown in Fig. 3 of the article in question, experienced operators will agree that all pockets in underground lines should be avoided and all changes in direction of the main line should be made with easy bends. A slug of water will pass bends such as shown in the illustration without doing any material damage and, if it can travel some distance without meeting with a sharp change in direction, will flatten out and be drained off by the trap pockets provided at intervals along the bottom of the pipe line. Traps cannot be depended upon to operate 100 per cent of the time, therefore any trapped pocket is a possible breeder of trouble. During periods of low steam flows slugs of water may accumulate in them to be picked up and shot down the line with the sudden increase in flow.

Out of a system of between three and four miles of underground steam line a section with pockets such as shown page 921, *Power*, Dec. 4 has proved the most treacherous when turning on and has given the most gasket trouble.

H. A. WARD.

Ithaca, New York.

Inconsistencies

YOUR editorial, "Common Sense Wins," in the Feb. 5 number represents the average opinion of a host of people who are unacquainted with the facts regarding lake diversion for sanitary purposes at Chicago.

You state that the withdrawal of 4,333 sec.-ft. at Chicago is wasting 250,000 hp. otherwise available in the Niagara and St. Lawrence Rivers, which at $20 per hp.-yr. is worth $5,000,000 annually, and that, owing to this withdrawal, the level of the great lakes has been so reduced as to interfere with navigation.

Of course you have since learned that the level of the lakes has increased so much in the last few years that millions of property damage has been caused not only at Chicago, but all around the lakes.

The shoaling of harbors is a continuous process and is not due to the relatively minute quantity of water passing down the Sanitary Canal. Silting occurs just as frequently in New York Harbor as in Chicago or Cleveland.

You repeatedly state that you are always in favor of the best economic solution of an engineering problem. A brief study will show that the level of the upper lakes can be controlled by weirs in the Detroit River which would in no wise affect navigation. Natural causes combined with sand dredging in the Detroit River resulted in the lowered levels which occurred a few years ago.

The continued withdrawal is and always will be necessary at Chicago, to avoid turning the lower end of Lake Michigan into a cesspool. There is no 100 per cent way of treating sewage commercially that will make it fit for drinking purposes. There is no other source of drinking water for the six million population using this source.

Economically, the elimination of diversion at Chicago will junk $125,000,000 of steam plants bordering the system, which will cost at least $150,000,000 to replace. To construct the rest of the treatment works (which has already cost the citizens of Chicago $225,000,000) will cost at least another $150,000,000 of doubtful commercial practicability. Interest charges alone on this sum, $300,000,000, amount to $15,000,000, plus the operating charges of, say, $10,000,000.

HARLAN W. BIRD,
Merchant Engineer.

Chicago, Ill.

[Chicago at the present time is allowed by a temporary permit granted in March, 1925, by the Secretary of War, to divert 8,500 sec.-ft. of water from Lake Michigan into its drainage canal for sanitary purposes. This is 4,333 sec.-ft. in excess of the 4,167 sec.-ft. that has been established by the Secretary of War as the maximum diversion that should be allowed. The Supreme Court decision upholds the authority of the Secretary of War to control the diversion from Lake Michigan. According to the ruling of the court the diversion must eventually be reduced to 4,167 sec.-ft. This means that 4,333 sec.-ft. that can now be diverted down Chicago's drainage canal will be allowed to flow in its natural course through the Niagara and St. Lawrence Rivers. When

the decision of the court is complied with, Chicago can still divert 4,167 sec.-ft. through its drainage canal, which is equivalent to nearly 2,700,000,000 gallons per day, which does not look like the elimination of diversion at Chicago.—Editor.]

Use of Sulphur in Finishing Sleeve Bearings

A SIMPLE and practical method of finishing bearings that we have used for some time might be helpful to other readers. The method is that of using a quantity of powdered sulphur in the oil reservoir or sump of a newly finished bearing to give it a good surface. We have had a number of close-fitting brass and bronze sleeve bearings on motors that were brought to as near a perfect fit and finish as could be desired by merely running the motor idle and having a quantity of powdered sulphur in the oil. Of course, after such treatment is finished, the oil reservoirs must be thoroughly flushed out with kerosene.

If, for any cause such as insufficient or inferior oil, a sleeve bearing fails in service and the attendant shuts the machine down before the bearing has dropped the babbitt, very often it can be saved by using the same sulphur trick. The scored parts of the bearing, which were the first spots to become overheated and seize, will be polished up by the slightly abrasive action of the powdered sulphur in the oil.

Of course such treatment is possible only on bearings that are lubricated by a liquid oil and is worthless on those that depend on hard oil or cup grease.

Denver, Colo. CARL A. WAGNER.

Going Over the Chief's Head

I HAVE read with interest the several articles that have appeared recently bearing upon the question, "Is an Employee Ever Justified in Going Over His Superior's Head?" This question, judging from the discussion, seems to have been taken too lightly, which to me indicates a lack of true appreciation of its importance. In my opinion the whole question centers around the one thought: "Does it Pay? if so, Why and How?"

I have spent a large portion of my life handling men, and whether we do or do not conscientiously apply the elements of psychology it matters little. Man is composed of many temperaments, characteristics and moods, all of which we must recognize and cater to in order to meet the ever changing personnel of the laboring class.

Well managed and efficient institutions in the industrial field recognize this fact and have established personnel departments under the leadership of specially trained management whose duty it is to hear and meet the wants and needs of the employee. This is usually done by establishing a "question box," in which the employee is encouraged to submit his views and suggestions. Some institutions even go so far as to give a prize or a bonus for worthwhile suggestions that can be of use to the company. In this way both the employee and employer share in the many worthy examples of thrift, safety and efficiency, all of which has a wonderful influence upon the morale of the personnel of every industry so affected.

In the April 2 number there appears a short editorial on "Loyalty Still Pays." It is well worth anyone's time to read and dwell upon this thought. As a rule we find the average American a rather independent individual This is characteristic since he has been born and bred more or less under this environment. We might term it "pronounced individuality." Many of our great inventions and appliances of today originated in the brain of the common man and were improved upon by the engineer of better training.

The so-called "Boss" is an employee also, as a rule, and belongs to the common herd. He should be open-minded as to the best thought of those under him and willing to work to the best interest of his employer. He should be that individual who can be "one of the boys," yet command that respect and admiration that build the morale of individual fellowship, so necessary in the field of this busy life of ours.

True, there are those who are inclined to knock occasionally. These individuals will soon be found out and the best place for them is outside the gate. Teamwork is what counts and you can have it only by pulling together.

There is no reason why an institution that employs men should not be one brotherhood. Efficiency and safety count most and these are usually more fully realized where there is a contented class of workers and a pleasant good-natured management.

Kokomo, Ind. ARTHUR C. HERREN.

Handling of Solid Fuels by the User

THE brief outline of fuel-handling equipment by R. K. Stockwell in the April 2 number contained a surprising announcement of information. I wish, however, to comment on one paragraph, in which he says: "For simple elevation, without distribution at the top, an automatic skip hoist is the most efficient installation, for the least investment, for capacities between 60 and 150 tons per hour." This is quite true, although many successful and economical skip-hoist installations above and below these capacity limits have been made. There are dozens of 25 to 30 ton-per-hour plants employing automatic skip hoists, and two plants, to my knowledge, handle upward of 400 tons per hour with this type of equipment.

The statement should be further qualified to the effect that distribution at the top presents no serious problem. In most plants the distribution into a long internal bunker is waste motion and embodies an extravagance of design that should be avoided, if possible, by the use of a central coal bunker and a distributing weigh larry. This eliminates the need for overhead bunker distribution and for the labor cost of an attendant at the bunker level. It also makes possible the delivery of any or all bunker coal to any boiler, in weighed amounts which are easily recorded.

However, where the internal bunker cannot be avoided, an automatic cable-driven tram car is frequently provided to furnish the necessary distribution. Being driven from the skip-hoist winding machine, it requires little additional equipment and operates in synchronism with the cycle of the automatic skip bucket. This combination device, developed for the steel industry years ago, has come into common use in the public-utility field. C. C. PLUMMER.

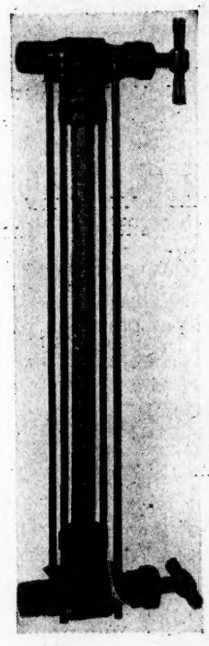
Chicago, Ill.

What's New in Plant Equipment

HOW THE MANUFACTURER CONTRIBUTES TO THE JOB OF GENERATING TRANSMITTING AND APPLYING THE POWER SERVICES

Level Gage with Turned Fittings

ALTHOUGH designed especially for use on filters and tanks, the level gage illustrated, manufactured by Wm. W. Nugent & Co., Inc., Chicago, Ill., is now available for various services. In order to insure freedom from blowholes and to obtain a good finish, every part of the gage is turned out of solid brass stock. The diameter of the glass is $\frac{5}{8}$ in. and the valve shanks are $\frac{3}{8}$- or $\frac{1}{2}$-in. pipe thread. The gage is available in lengths from a few inches to 36 in. center to center of fittings. It is now being used as standard equipment on all filters and tanks put out by the company.



Oil level gage

New Furnace Water Wall Uses Small Tubes and Forced Circulation

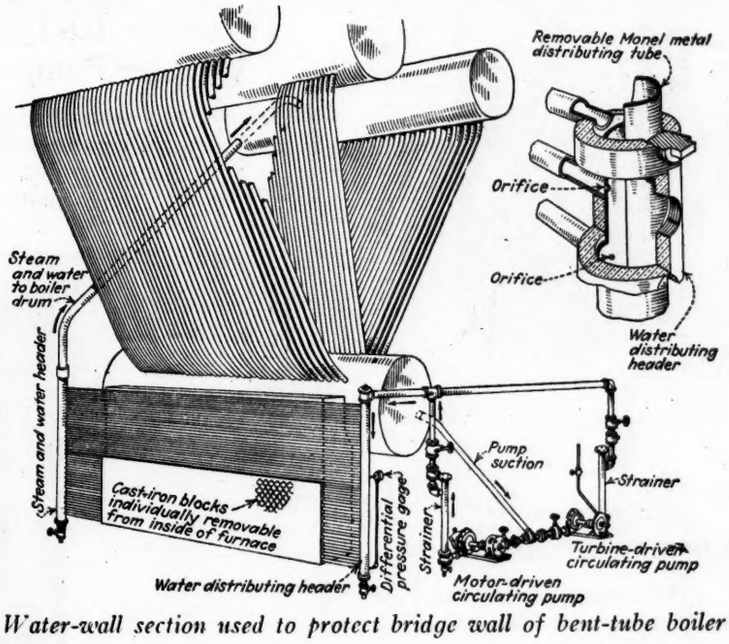
IN THE Nov. 23, 1926, number the La Mont steam generator, in which small tubes ($\frac{5}{8}$-in.) and forced circulation are used, was illustrated and described. The principle involved in the design of this boiler is that of injecting a small but oversufficient amount of water into one end of a bank of tubes in such a manner that the water forms a film on the interior of the tube. In passing along the tube, only part of the water is turned into steam, the remainder, together with the steam formed, passing out at the other end into a manifold or header and thence to a separating drum.

A new type of furnace water wall, known as the Riley-La Mont, in which this same principle is used, is being put out by the Riley Stoker Corporation, Worcester, Mass. The general arrangement of wall as used to protect the bridge wall of a bent-tube boiler is shown in the illustration.

Positive circulation in the tubes is maintained in a single direction by means of a centrifugal pump of proper characteristics and by distributing orifices which meter the proper quantity of water to each tube. Water enters the circulating pump by gravity from a drum of the boiler, and its pressure is increased by the pump 15 to 40 lb., depending upon the rate of heat absorption of the water wall.

The capacity of the orifices in the distributing header is such that the quantity of water forced into each tube is several times the quantity that will be evaporated under the condition of maximum heat absorption. This water, however, is insufficient to fill the tube. As heat is absorbed in the tube, part of the water is turned into steam which, compared to the quantity of water, is very great in volume. This steam and excess water leaves the other end of the tube, enters the header and passes into the steam space of the boiler. The tubes are long compared to their cross-sectional area, so that the steam generated produces exceedingly high velocities in the tubes. The high velocities, together with the positive circulation, preclude the possibility of steam binding in the tubes. Further, with this construction the tubes may be installed vertically, horizontally or at any desired angle with the flow either up or down, and the tubes can be bent at any angle to avoid structural obstacles and furnace openings.

Some of the advantages claimed for this system of water-wall construction by the manufacturer are: It eliminates steam binding and tube failure because of this condition; owing to the flexibility of the small tubes, expansion and contraction will not cause leaks at the water-wall headers: its adaptability permits its installation where it would be impossible to make use of the natural circulation type of water wall (this is particularly advantageous where it is desired to install water walls on existing boilers); the high velocity through the tubes interferes with the formation of scale or other feedwater deposits: it obviates the necessity of using refractory or cast-iron blocks to decrease the rate of heat absorption of the water wall.

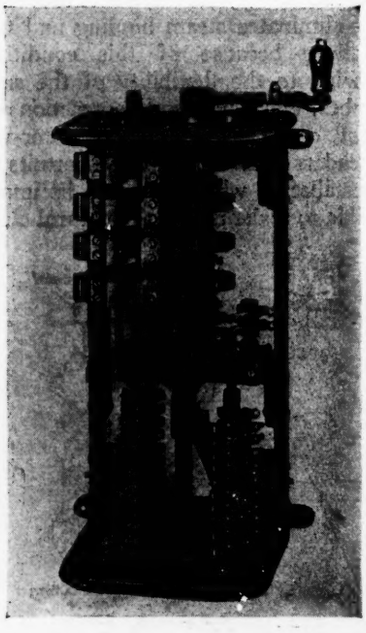


Water-wall section used to protect bridge wall of bent-tube boiler

Direct-Current Cam Switch

A NEW direct-current cam switch designed especially for non-reversing service is announced by the General Electric Company, Schenectady, N. Y. The switch is partiularly suited for controlling auxiliaries, such as pumps, blowers and similar equipment in power plants, and other services where the current inrush or the starting torque is not severe or where the operations are not frequent.

The switch is available in two forms, Both are for non-reversing service with an armature regulation over five points, and one form has field regulation over 22 points. The intermittent armature current capacity is 1,000 amperes while the same capacity, continuous rating is 550 amperes at 550 volts maximum.

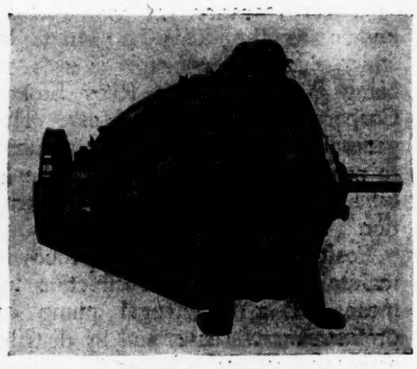


Cam switch with cover removed

Fan-Cooled Direct-Current Motor

IN THE new type-SK motor recently announced by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., the standard type-SK construction and parts have been utilized. All mechanical parts with the exception of the shaft are interchangeable with those parts used on the present totally inclosed motor of the same frame size. The essential mounting dimensions of the new-type motor are also the same as on the standard open-type.

With the addition of the forced air cooling, the bracket openings are fitted with covers and sealed sleeve bearings are used. The commutator end of the motor is further inclosed with a sheet-steel cover which has a perforated protective end through which the fan draws the cooling air.

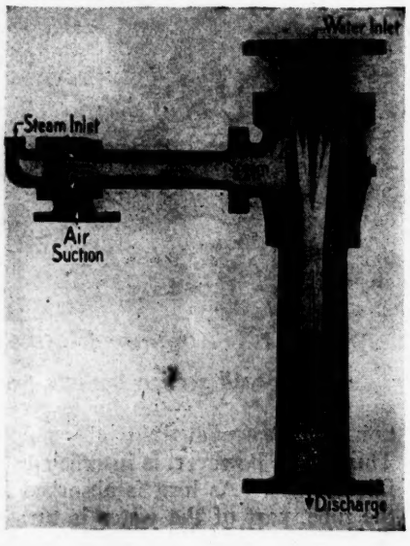


Type-SK motor with upper inclosing cover removed

The air is directed over the bracket and passes out over the top of the motor. The motor is adaptable for use with the various types of equipment where the surrounding air is full of foreign matter that may be injurious to the motor winding.

Two-Stage Jet-Type Vacuum Pump

THE hydro-steam two-stage vacuum pump shown in the illustration is a development of a combination of the older multi-nozzle,



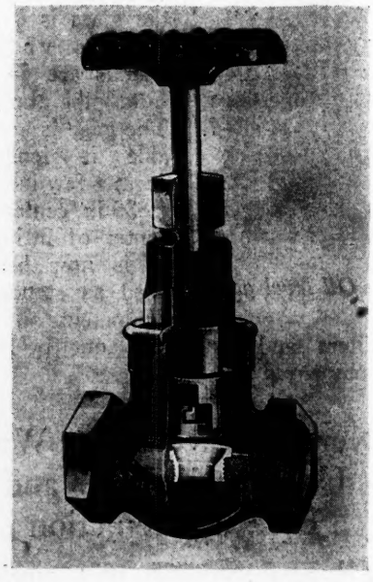
Steam- and water-jet vacuum pump

steam-jet and water-jet exhausters made by the Schutte & Koerting Company, Philadelphia, Pa. The pump operates without inter- or after-condensers. The multi-nozzle steam-jet primary machine discharges directly into the multi-nozzle secondary stage, which is a water-operated unit. Both stages work on the jet principle, the high-velocity steam jets in the primary stage entraining the air at high vacuum, while the water jets in the second stage handle both steam and air from the first-stage machine.

This type of vacuum pump is suitable for installation where simplicity of piping and minimum regulation are important features. The pumps are capable of producing vacuum in excess of 29 in. for normal operation, and are built in five standard sizes, with suction connections varying between two and six inches.

Self-Grinding Globe and Angle Valves

THE principal feature of the self-grinding globe and angle valves made by the Kelly Company, 372



Cross-section of Kelly self-grinding valve

W. Grand Ave., Chicago, is the use of a spring and stem bushing inside the standard bonnet, the bushing instead of the bonnet carrying the threads for the stem. The bushing moves up and down through a limited travel, when the stem is screwed in or out, and after the disk comes in contact with the seat, it is permitted to rotate for one complete turn of the wheel handle, creating in this way a grinding action every time the valve is opened or closed.

When the valve is being closed, the

bushing moves down to its lower limit, and as the seat and disk make contact, the bushing starts to rise against the compression of the spring and continues its upper movement until it comes in contact with the lower lip of the bonnet and assumes a locked position to give a metal-to-metal contact, eliminating the spring action. The lower limit of travel of this bushing is regulated by a small shelf cast in the body of the valve, which comes in contact with the deep notch in the bushing. The shallow and wide notch in the bushing fits over this shelf. The bushing is thereby prevented from turning, but is left free to rise or fall as the case may be, within certain limits.

The compression of the spring is so adjusted that when a valve is completely closed, should any contraction of the stem occur owing to the cooling off of the valve, the spring will hold the disk to its seat against the pressure. In case the ordinary grinding action of closing the valve is not sufficient to keep it tight, it can be ground to a new seat by rotating the wheel back and forth. The rotating and grinding action of the disk on the seat tends to cut away any deposit of scale or sediment and maintain a clean metal-to-metal contact.

These valves are made in sizes from ¼ to 2 in. in diameter and for two pressures, 150 and 300 lb. The material used is steam metal bronze, while the renewable seats are of Monel metal.

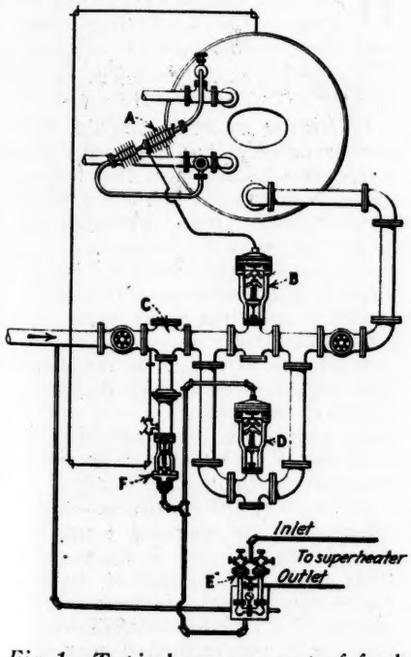


Fig. 1—Typical arrangement of feed-water regulator operated by water level and steam flow

Feed-Water Regulator for Large Boilers Operating at High Ratings

THE comparatively small water capacity of the large boilers now in operation, as compared to the high rate of evaporation and the tendency of these high ratings to cause wide fluctuations in the water level with sudden changes in load, has necessitated important improvements in feed-water regulators to insure constant and adequate supply of water to the boilers. The accompanying illustrations show the changes made to the S-C regulator manufactured by the Swartwout Company, Cleveland, Ohio, to take care of the new duties imposed by the larger units operating at higher ratings.

In the arrangement shown in Fig. 1 the pressure generator *A*, feed regulating valve *B* and the differential pressure regulator *C* are standard equipment, with the valve *D* and master control *E* added to take care of the flow at high ratings. The operation of the regulator is as follows:

At normal and considerably above normal rating the valve *B* is sufficient to take care of the required feed. But in the event of a sudden increased demand on the boiler, the pressure in the drums drops slightly, the ebullition increases and the water level rises correspondingly. When this takes place the valve *B* tends to close owing to the higher water level, while actually more water must be fed to take care of the increased steam demand.

To do this, the valve *D* is inserted in a bypass around the valve *B* with the diaphragm chamber connected to the master control *E*, which in turn is connected with the inlet and outlet of the superheater or across an orifice. The master control is arranged to open the valve *D* when the drop through the superheater or across the orifice reaches a certain value, the drop varying directly with the rating on the boiler.

As the differential pressure must also be changed with the increased demand, an additional diaphragm head *F* is added to the standard valve *C* and connected with the differential master control *E*. The head *F* is used simply to give increased loading on the valve *C*, but is not connected in any way with the operating stem of the valve. This permits the valve *C* to function normally at the lighter loads. Regulators are now available for pressures up to 1,350 pounds.

For the higher pressures a special design of valve and seat is used. The small pressure connections are screwed and welded and through studs with nuts one each end are used in the flanged joints.

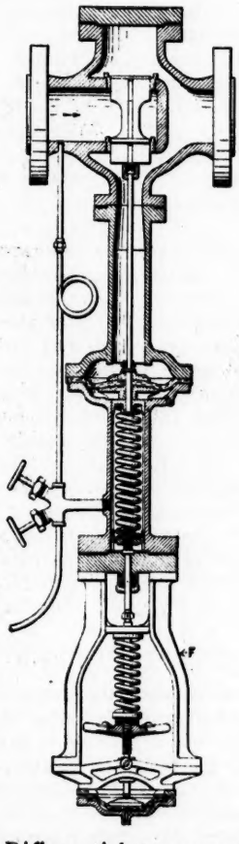


Fig. 2—Differential pressure regulating valve with extra loading attachment for high rates of flow

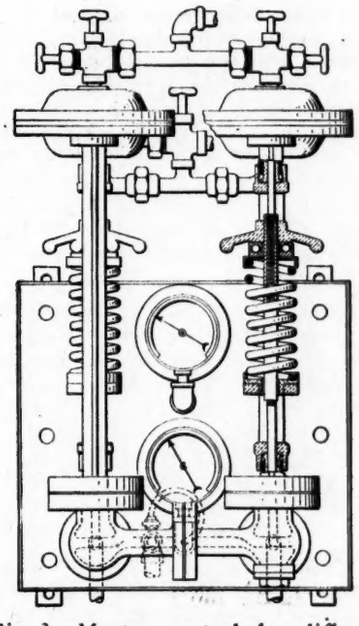


Fig. 3—Master control for differential-pressure valve and extra feed valve

FROM AMONG THE READERS'

Conducted
By
L. H. Morrison

WORKING AN INJECTOR WITH SUPERHEATED STEAM.—*Will an injector work satisfactorily with steam at 250 lb. pressure and superheated 100 deg. F.?* M.C.

There is no reason why an injector should not operate on superheated steam. The action should be better than if the steam was wet, and in most installations by the time the steam reaches the injector much of the superheat will have been lost.

EFFECT OF COMPRESSION IN A STEAM ENGINE.—*Is it a fact that increasing compression will make a steam engine run less noisily?* B.F.A.

Whether an engine should have more or less compression to make it run more smoothly depends upon the magnitude of the inertial forces. This in turn depends upon the weight of the reciprocating parts and upon the speed. In some cases compression should be reduced and in others an increase would be of advantage.

PRESSURE ON SCREW CAPSTAN.—*What pressure is exerted by a capstan screw that has four threads per inch and has a lever 30 inches long?* J.B.A.

In making a complete turn of the lever the work done in foot-pounds is $2\pi RF$, when $2\pi R$ is the circumference of the circle swept by the point on the lever at which force is applied, here taken at the extreme end, and F is the force applied in pounds. During a complete turn of the lever the screw also makes a complete turn and moves in its nut a distance equal to the pitch, which is $\frac{1}{4}$ in., as there are four threads per inch. This pitch in feet is $\frac{1}{48}$. The work done in the moving of the lever a complete turn is equal to the work done by the screw in raising a weight, ignoring friction. In other words, if we call W the weight lifted, we have $2\pi RF$ = pitch $\times$ W, or $2 \times 3.1416 \times \frac{30}{12} F = \frac{1}{48} W$. This reduces to the expansion $754F = W$; and if a force of 10 lb. be exerted on the lever, 7,540 lb. will be lifted by the screw.

PUTTING UNIFLOW CYLINDER ON EXISTING ENGINE.—*Our Corliss engine is in good condition, but has a steam consumption of about 30 lb. per brake horsepower-hour. An offer has been made to replace the Corliss cylinder by a uniflow cylinder, the claim being that the steam consumption would drop to about 22 lb. Is this a safe procedure?* C.C.D.

Undoubtedly, the uniflow cylinder would better the steam consumption. However, to deliver the same horsepower with the same r.p.m. and initial pressure, the uniflow cylinder must have a larger diameter. This is for the reason that to obtain the desired economy the uniflow must have a cutoff earlier than with the Corliss, and as compression starts early, the area of the indicator diagram is reduced, showing that the mean effective pressure has been reduced, which must be compensated for by making the cylinder diameter large.

In view of these facts the crankshaft, crankpin, rod and main bearing must withstand increased stresses and their strength should be calculated before replacement is started.

VALVE SEATS IN ALUMINUM CYLINDER HEADS.—*We are developing a gas engine with aluminum heads. It is necessary to use removable valve seats. Our problem is the method of reseating these rings. The first idea was to place the rings in the mold and cast the aluminum around them. But this has certain disadvantages. Is there another method?* J.J.C.

The rings could be threaded and screwed into the aluminum, but as the rate of expansion of the two metals is quite different, it would probably be difficult to make a tight joint.

The best method, doubtless, is to chill the ring sufficiently to permit it being set into the recess. Why not use liquid air for the chilling? This would give a temperature difference of around 250 deg. F.

DIRECT-CURRENT GENERATOR SHIRKS ITS LOAD.—*In the plant I have charge of there is a 350-ampere 120-volt direct-current generator directly connected to a steam engine. This machine was originally designed for 250-volt operation, but has been rewound for 120 volts. When started, the machine's voltage readily builds up and it takes full load of 350 amperes. This machine operates in parallel with three other machines, rated at 1,000, 830 and 350 amperes respectively. After the machine under discussion has been in operation about 30 minutes, it begins to drop its load and adjusting the field rheostat will not correct this condition. What could cause this trouble?* R.B.A.

Assuming that the prime mover is functioning properly, one of the first things to make sure of is that all connections are tight and in good condition. Check the machine's field rheostat to determine the condition of the contacts. Sometimes the moving contact gets out of adjustment and does not make good connection. It would also be advisable to check the connections between the field coils of the machine giving trouble. When these are in good condition, test the coils for short circuits by taking the drop of potential across each coil with a voltmeter.

Check the connections between the generator and the busbars. It is possible that the equalizer and the series-field connections are crossed, which would cause the generator to operate as a shunt machine.

When it has been determined that the machine is in good condition and its connections are made correctly, if it still gives trouble a test should be made to determine the voltage regulation characteristics of the machines. This test consists of adjusting the voltage of the machine to normal value at no load, then increasing the load and taking readings of voltage and load at, say, 25, 50, 75, 100 and 125 per cent load. From these readings plot a curve. The curve for the machine that is giving trouble should be the same as those for the other machines, if it is to operate satisfactorily in parallel with them. The voltage characteristics of a machine may be adjusted in various ways such as changing the position of the brushes on the commutator, changing the number of turns in the series-field winding, adjusting the series-field-winding shunt, changing the size or length of the cables between the machines and the busbars, changing the length of the air gap between the field poles and the armature, and by changing the speed of the machine.

The foregoing statements have been made on the assumption that all the machines are of the simple compound-wound type.

HIGH AND LOW HEAT VALUE OF A FUEL.—*When discussing combustion what is meant by the expression, "The efficiency is based on the high heat value?"* J.C.P.

Practically all fuels contain hydrogen, expecially gas and oil. When combustion takes place, this hydrogen unites with oxygen in the air to form water vapor. This superheated steam passes out with the remainder of the gas of combustion, carrying with it the latent heat of evaporation plus the heat needed to raise the water vapor to the stack temperature.

If we take 32 deg. F. as the standard base temperature, we must deduct from the total heat value of the fuel the latent heat of the steam or water vapor at 32 deg. F. This may be obtained by Reynault's formula,

$$Heat = 1{,}091.7 - 0.695\,(t - 32)$$

where t is the observed temperature. At 32 deg. F. this becomes 1,091.7 B.t.u. As one pound of hydrogen forms nine pounds of water, we must subtract $9 \times 1{,}091.7 = 9{,}825$ from the total heat of hydrogen combustion, 62,100 B.t.u., giving 32,275 B.t.u. as the lower heating value of a pound of hydrogen.

PROBLEMS

ANSWERS

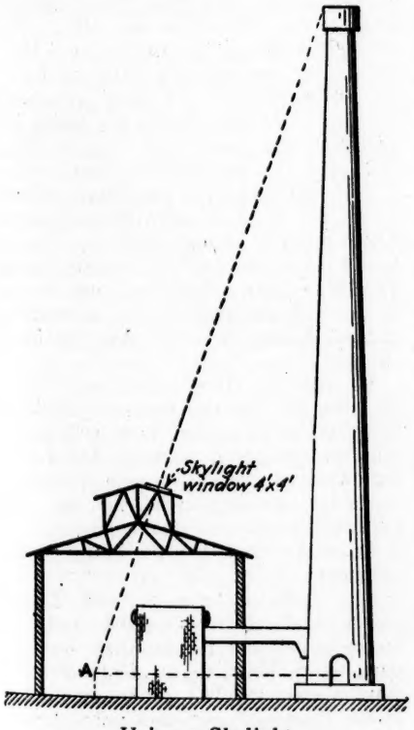
from Our Readers

THE QUESTION

DESIRING to observe the volume of smoke emitted by our two stacks, without leaving the boiler room, I have thought of employing the principle of the periscope for this purpose.

What is the best arrangement to use? The height of the stacks, from the boiler-room floor is 175 feet, distance between stacks, 18 feet. J. L.

THERE are several types of smoke-observation instruments manufactured; one that deserves particular merit was designed by Walter Kidder, consulting engineer, of New York City.



Using a Skylight

A quick, practical and inexpensive method of providing facilities for smoke observations may be found in the time-honored skylight window shown in the illustration. E. A. BARER.

Bayonne, N. J.

AT THE Connors Creek plant of the Detroit Edison Company, as well as at other plants of the same company, the engineering department installed mirrors out of doors so that the operator could look out of the window, through a special pane of plate glass, and in the mirror see a reflection of the stacks.

At Connors Creek, in order to show all seven stacks in one mirror, the mirror was made convex, like some of the automobile "police" mirrors. This mirror was three or four feet in diameter and made to a spherical surface with a radius that was calculated by one of the engineers. It was not so expensive as one might suppose, for it was not a ground surface. The glass works simply made up a plaster, spherical surface, laid it on a piece of plate glass, and heated it in a surface until the glass sagged and fitted the surface. The result was a somewhat wavy mirror, but it did show the seven stacks.

At the point of observation there was a series of seven light switches controlling red lights located at the boiler-control panels, so that the observer could easily notify any fireman of a smoking stack. This arrangement worked out nicely, but is applicable only where there is space out of doors.

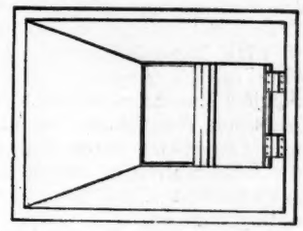
Cambridge, Mass. C. H. BERRY.

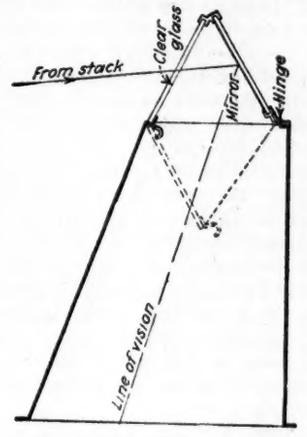
THE accompanying sketch shows a device which I had made for smoke observation, and which has proved very successful.

The box was made of sheet iron of the same dimensions as the opening of a window pane. The edge was flanged so that it could be fastened in the sash, the same as the glass pane which it replaced.

The part that holds the mirror is hinged at the bottom so that it can be turned back and just closes up the opening in the front of the box. When the mirror is turned back in, the clear glass is protected from dust and snow and it is possible to clean the glass from the inside of the building. The mirror is 4x6 in. and cost 15 cents.

In some instances the box would not be necessary. In my case a window



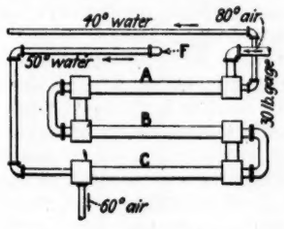


A Window-Mirror Design

that swings outward and is only a few feet above the mirror made the box necessary. L. G. GRIEBLING.

Akron, Ohio.

A Question For Our Readers



IN our plant air at 30 lb. gage and about 80 deg. F. is put through a water cooler, consisting of the double-pipe coils *A*, *B* and *C*, and then goes to a dehumidifier. The air goes into the cooler at 80 deg. and comes out at 60 deg.; the air goes in at 50 deg. and discharges at 40 deg. How can this be?

R. B. C.

Suitable answers from readers will be paid for and published in the May 28 issue.

Diesel Engines for Office Buildings
Interest Mechanical Engineers

AT THE Metropolitan Section Meeting of the American Society of Mechanical Engineers, at the Engineering Building, New York City, on April 24, a large audience listened to a paper on the "Application of Diesel Engines to Office Buildings," by Edgar J. Kates, consulting engineer.

In his paper the author held that the Diesel engine is worthy of study on the part of owners and managers of office, loft and hotel buildings, as there are certain inherent characteristics of Diesel engines that make them particularly suited to this service.

Even in units as small as 100 kw. capacity, the cost of fuel per kw.-hr., based on 7-cent oil, is only 0.7 cents. A Diesel engine is a complete power plant in itself and occupies but little space. For example, the over-all dimensions of a 160-kw. Diesel generating unit complete are only 6 ft. wide by 17 ft. long by 8 ft. high. Another 4 ft. of height will allow ample headroom for removing pistons.

Certain problems must indeed be faced in the application of Diesel engines to large buildings, but they can be successfully solved in the light of modern knowledge. Of interest in this connection are studies of reliability, maintenance cost, vibration and noise.

Engine Reliability

Investigation shows the reliability of modern Diesel engines to be so well established that it ought not to be a matter for concern. About one-fifth of the country's oil engines are running in the pumping stations on the oil pipe lines, the duty of which is very severe. These stations are in continuous service, 24 hours a day, every day in the month, and the load is large and steady, averaging 85 to 90 per cent of rating. This sort of service is a severe test of reliability, yet typical records of operation show a dependability exceeding 99 per cent, month after month.

A near-by example of reliability in industrial service is a 200-kw. Diesel generating unit that has been running for five years in a Brooklyn factory, operating 24 hours a day continuously for periods of four weeks at a time and then being shut down for about six hours for inspection and minor adjustments. This engine has never had a forced shutdown.

Diesel reliability is helped by the simplicity of the plant equipment, as the plant comprises merely the engine itself and a few simple auxiliaries such as the water-circulating pump and the starting air compressor.

Records of engines that have been used in various commercial services from five to ten years show a cost of maintenance and repairs about .05c. per rated horsepower per hour, and it seems safe to assume that present-day engines will show less. This is equivalent to 8c. per hour for a 100-kw. unit.

It is impossible to transmit vibrations from an engine to a building either through the soil or through the piping. However, with proper care in the selection of the engine and in the manner of installation, all objectionable vibration may be avoided. Suitable engines are available of the multi-cylinder type with comparatively small cylinders. Their lighter moving parts and their better mechanical balance practically eliminate vibration. Other factors that enter into this smoothness of operation are large-diameter, stiff crankshafts, counterweights and the use of cork mats under the foundations. Flexible connections should be employed in the piping to prevent the transmission of vibration, and spring mounting may be used for the engine itself.

Noise Can Be Avoided

The noises that may arise from Diesel engines come principally from the sound of the exhaust gases discharged to the atmosphere, the sound of the air-intake, and the valve motion. Numerous installations show that the exhaust and air noises can be completely eliminated by the use of silencers of the Maxim type.

Considered as a heat engine the Diesel is much more efficient than steam units, and consequently the Diesel discards less heat than will a steam engine. In addition this heat can be recovered with little extra equipment.

The recovery of the waste is especially valuable in mild weather, when it permits shutting down a fuel-burning boiler plant or discontinuing the purchase of street steam. An excellent use for this heat is for the hot-water service of the building. Another use is in combination steam and Diesel plants, where the Diesel jacket water at, say, 140 deg. F. can be piped directly to the boiler feed-water heater, thus recovering about 27 per cent of the heat of the Diesel fuel at no cost or complication whatever.

Labor Costs Are Low

The amount of attendance required in Diesel power plants is being reduced, both because the engines themselves are being made more simple and more rugged, and because various forms of automatic control are being introduced to relieve the operator of routine duties. The modern engine requires but little operating attention. The feeding of fuel, of lubricating oil and of cooling water is quite automatic, and any derangement can be guarded against.

All buildings require heat as well as power, and it is necessary, therefore, to consider the heat requirements along with the power needs. These can be served by many possible combinations, such as:

1. Diesels for power, steam boilers for heat only.
2. Steam boilers and steam engines for heat and power.
3. Diesels for power, street steam for heat only.
4. Street steam for heat and power.
5. Steam boilers with steam engines and Diesel engines in various proportions.

The simplest method is to use Diesel engines for power and street steam for the heat required beyond that recoverable from the Diesels. This scheme is particularly applicable in certain sections of downtown New York, where street steam is available and the basement space is too limited or too valuable for a boiler plant.

A study was made on one office building, and a plant was designed to contain four Diesel generating units of 120 kw. each. Three units would carry the peak load of 350 kw., and at least one spare unit would be available at all times. One unit would carry the night load, which is less than 120 kw. during the entire period from 6:30 p.m. to 4:30 a.m. The total room space occupied would be an area of about 34 ft. by 48 ft. and about 12 ft. high.

Cost of Power

The cost of electrical current generated in this proposed Diesel power plant is summarized in the table. The net operating cost for producing 1,165,400 kw.-hr. per year is $13,032, or 1.12c. per kilowatt-hour. Adding overhead charges of 12 per cent on the entire investment, the total annual cost is $22,272, or 1.91c. per kilowatt-hour.

The annual bill for purchased current is $35,264 or 3.03c. per kilowatt-hour. These figures indicate that the Diesel power plant would effect a net saving of $12,992 a year, which is a net return of over 16 per cent on the investment in the addition to the 12 per cent fixed charges.

To install a Diesel plant in a building like the one described requires an initial outlay equivalent to several years' bills for purchased current. The building owner can take advantage of modern financing services whereby he can gradually acquire a valuable power plant at no outlay other than the initial down-payment.

For instance, the $77,000 Diesel power plant referred to can be installed at an outlay, on the building owner's part, of $23,000 (equivalent to eight months' electric bills), the balance being in the form of 6 per cent notes covering a period of five years. The savings

in operating costs, compared to the bills for purchased power, amount to $22,232 a year. This sum will not only suffice to meet the finance company's notes and interest payments, but will give a surplus of about $8,000 a year which can be used to retire the owner's $23,000 initial outlay. Thus the owner's outlay will be retired within three years, after which he will make a net saving of $8,000 annually. In two years more, or five in all, the finance company will have been completely repaid, whereupon the building owner will make net savings of over $22,000 each year for the life of the plant, another ten or fifteen years. This is an attractive return on a $23,000 outlay, which is itself repaid in only three years.

SUMMARY OF COST OF DIESEL POWER

Building rentable area	235,000 sq.ft.
Annual consumption of electricity	1,165,400 kw.-hrs.
Peak load	350 kw.
Investment in 480-kw. Diesel plant	$77,000

Diesel Power Costs

	Dollars per Year
Fuel, 1,165,400 kw.-hr. at 70c	$8,158
Lubricating oil, at 60c	864
Attendance	6,760
Maintenance	1,440
Gross operating costs	$17,222
Credit for street steam saved through recovery of Diesel heat, 1,165,400x4.5x.80 / 1,000	$4,190
Net operating cost	$13,032
Overhead charges, 12 per cent of $77,000	9,240
	$22,272

COMPARISON WITH COST OF PURCHASED CURRENT

	Dollars Per Year
1,165,400 kw.-hr. at existing wholesale rate	$32,933
1,165,400 kw.-hr. at $0.002 coal surcharge	2,331
Attendance and overhead charges on investment disregarded	0
	$35,264
Net saving with Diesel power	$12,992
Net return on investment (besides 12 per cent overhead charges), per cent	16.8
Operating saving with Diesel power	$22,232
Time to retire Diesel Investment	Under 4 years

Discussion

The paper evoked considerable discussion. Much of this confirmed, in the main, Mr. Kates' claims and figures; two or three speakers representing the central-station viewpoint, contended that both the operating and the fixed charges as given in the paper were too low; and several, representing the building managers, pointed out local conditions that might stand in the way of using Diesels.

A. H. Morgan, representing the Building Managers' Association, conceded the reliability of the Diesel, but expressed some apprehensions as to noise and vibration. One case was mentioned where a turbine mounted on rock foundation produced objectionable vibration on the twelfth floor only. In reply to this one of the speakers cited a noiseless and vibrationless Diesel installation in a Brooklyn building. Mr. Morgan further cited the New York City regulations pertaining to the storage of fuel oil, which require the tank to be inclosed with 8- to 10-in. concrete walls and prohibit any such storage within twenty feet of a subway. This last regulation would rule out many buildings along subway routes and, if the tank be placed under the engine room, would in many cases involve expensive rock excavation. He also called attention to the fact that Mr. Kates, in making comparisons with purchased power, had not charged in rental for engine-room space. This would average about one dollar per square foot for vault or file space and considerably more for space suitable for cafeterias.

H. A. Pratt, of Ingersoll-Rand Company, cited some very successful Diesel-engine installations in the vicinity of New York, but pointed out that vibration is something to be looked into carefully. "While a Diesel is not a cure-all," he said, "any man who owns a building and wants to save from every angle should look into the Diesel."

A. S. Morgan, representing the central-station interests, cited N.E.L.A. reports on Diesel-engine operation to show that the consumption of lubricating oil as given by Mr. Kates was far too low; that the initial cost would be around $175 per kilowatt instead of $160; that the maintenance would be double that given in the paper; that the fixed charges should be taken at 15 per cent; and that engine-room space should be charged at two dollars per square foot. This would bring the total cost to over three cents per kilowatt-hour.

L. H. Morrison, who presided, took issue with the N.E.L.A. figures on lubricating-oil consumption on the grounds that these figures represented averages of a number of engines, some of which were of old designs, that were heavy users of oil.

Other speakers were of the opinion that 22 to 25 per cent annual load factor would come closer to the picture than the 38 per cent assumed by Mr. Kates. It was also pointed out that one additional operator would be needed and that the engineer's pay might easily exceed the assumed figure.

The uniflow steam engine was not without its adherents, and the claim was made that, had the paper given due credit to the steam demand, the steam engine would have proved the most economical in the cases under discussion.

It appeared to be the general consensus of opinion, however, that the Diesel, while not applicable to all types of building service, is at least a factor to be considered, and that each case presents its individual problem.

Recent Publications

THE THEORY OF HEAT ENGINES. Third Edition. By William Inchley, late professor of University College, Nottingham, England. Revised and amended by A. Morley. Published by Longmans, Green & Company, 55 Fifth Ave., New York, 1929. Cloth; 5½x8½ in.; illustrated; 504 pages. Price $5.

THIS work is a mathematical textbook dealing with steam engines and turbines, refrigeration, gas and oil engines, steam flow, heat transmission, combustion, valve gears, governors, balancing and kindred subjects. It is primarily intended for engineering college students and for those studying for civil-service and other examinations. It contains between the covers of one volume, what the engineer needs to know for such tests and what elsewhere could be obtained only by the use of several volumes.

Another advantage of the work is that the treatment is concise and clear. On the other hand, the explanations are not extended and a knowledge of mathematics and physics is presupposed, thus limiting the usefulness of the volume to those who are well-grounded in the fundamentals.

The new edition has been corrected and amended wherever necessary and an appendix has been added. In this appendix new subjects, such as reheating and steam bleeding, are treated. The volume can be recommended for use by all technically trained engineers and by others who have the requisite mathematical background.

CODE FOR PRESSURE PIPING.—The American Society of Mechanical Engineers has issued a proposed American recommended practice code for pressure piping covering gas and air piping systems. The code contains a systematic classification of material specifications for pipes, fittings and valves, together with general requirements for hangers, coverings, inspections and tests. This is the first section of the code for pressure piping to be completed. Other sections will cover power piping, hydraulic piping, oil piping, refrigeration piping, piping materials and fabrication details. Criticism and discussion of this section of the code will be welcomed and should be addressed to C. B. LePage, Assistant Secretary, A.S.M.E., 29 West 39th Street, New York City.

OPPORTUNITIES FOR ENGINEERS IN THE UNITED STATES CIVIL SERVICE is the title of a 43-page booklet issued by the United States Civil Service Commission, Washington, D. C. The United States Government service offers many opportunities for the acquisition of a diversified engineering experience. Included in the federal service are more than 3,500 professional engineers. The activities of this force embrace practically every branch of endeavor to which engineering is applied. In this booklet are outlined the opportunities afforded engineers in the various government departments. Tables are included that show the distribution of engineers in each department and the salaries paid.

Water Power vs. Steam Power

The position of water power with relation to steam was discussed on April 16 by O. C. Merrill, executive secretary of the Federal Power Commission, in an address before the engineering students of Princeton University. This abstract of his speech gives facts pertinent to the future of power development.

WHILE the development of water power has increased rapidly in recent years, owing partly to the removal of restrictions formerly existing on sites under government ownership or control and partly to the rapid expansion in power development as a whole, particularly for public-utility uses, less than one-fourth of the generating equipment in public-utility and manufacturing plants is operated by water power.

According to the reports of the Bureau of the Census the total installation in prime movers in central stations and electric railways—that is, in public-utility use—in 1902 was 3,200,000 hp., of which less than 500,000 hp., or 15 per cent, was water power. The estimated installation in manufacturing plants for the same year was 10,054,000 hp., of which 1,570,000 hp. was water power, likewise 15 per cent of the total. Twenty-five years later, in 1927, the total installation in public-utility stations had increased to 38,623,000 hp., of which 10,374,000 hp., or 27 per cent, was water power; while installation in manufacturing plants had increased to only 18,200,000 hp., of which 1,800,000 hp., or approximately 10 per cent, was water power.

Manufacturing Plants Increasingly Use Public Utilities for Power

It is significant of the increasing part that the public utilities are taking in the production of power, both relatively and absolutely, that in the 25 years from 1902 to 1927 the installed capacity in public-utility plants increased 12 times, while that in manufacturing plants increased only 30 per cent. During these 25 years public-utility plants added over 35,000,000 hp. of new equipment, the manufacturing plants only about 8,000,000 hp.; that is, manufacturing plants have to an increasing degree supplied their power requirements from the public utilities.

The effect of the growth of public utilities upon water-power development is shown by the fact that while the water power developed by these utilities increased in the 25 years from less than 500,000 hp. to more than 10,000,000 hp., water power in manufacturing plants was practically stationary, increasing only about 10 per cent. Taking public utilities and manufactures together, water power operated 15.5 per cent of the total installation in 1902 and 21.5 per cent in 1927.

There are two chief reasons why, notwithstanding the greater percentage increase in water power in the last 25 years, it is likely always to play in this country a subordinate rôle to fuel power. One of these is the relative cost of supplying energy from the two sources. During the 25 years we have been considering, the efficiencies of water turbines have increased from around 60 or 70 per cent to well over 90 per cent, and have now reached about the limit of practical mechanical efficiency. The steam plant, on the other hand, if we measure its increased efficiency by the fuel consumed per unit of output, has improved to a far greater degree and is still improving.

The fuel stations of 1902 used around four pounds of coal per kilowatt-hour produced. The modern high-pressure, high-temperature fuel power station, such as the Richmond Street plant of Philadelphia Electric Company, operating with a load factor around 60 per cent, uses less than one pound of coal, or about 13,300 B.t.u. per kilowatt-hour. We do not know what further efficiencies may yet be developed. For example, the mercury vapor turbine is still in the experimental stage. One unit of 10,000 kw. has been installed at a station in Hartford, Connecticut, and its short period of operation indicates that it may produce a kilowatt-hour with less than 10,000 B.t.u.

Only Best Hydro-Stations Can Compete with Steam

As a result of the improvements in fuel station efficiencies, only the best of hydro-electric stations—that is, those with a regular supply of water and of relatively cheap cost of construction—can, when independently operated, deliver power at any considerable distance as cheaply as it can be produced by steam. This situation is a deterrent to water-power development in a section where cheap coal can be had. It by no means follows, however, that hydro stations are out of the running, for it frequently happens that the two types of plants in combination can deliver power more cheaply than either alone.

The Conowingo development on the Susquehanna is an example of a modern method of combining hydro and steam plants when the former has a considerable water storage capacity. Here a hydro plant with a primary power capacity at low water of less than 50,000 hp., is to have an installation of approximately 590,000 hp. The dam was the most expensive item of the construction and involved a fixed cost whether the installation was 50,000 or 500,000 hp. The cost of additional units for developing power in excess of the primary capacity was less than the cost of steam units of like capacity. When there is a plentiful supply of water in the river, the hydro plant can produce kilowatt-hours at a cost less than the fuel cost of the steam plant. When water is low, the hydro plant can be operated on peak load using a 24-hour supply of water in four to six hours, and thus serve as a substitute for high-cost steam units for peak-load operation. This is an example of what is becoming a common practice, when conditions permit, of operating hydro and fuel plants in combination, the former to take the variable peak load, the latter the continuous base load.

Water Power Sites Not Convenient to Industrial Plants

There is another factor that will cause delay in the full utilization of our water-power resources, and that is their geographical distribution. More than 70 per cent of these resources are on or near the Pacific Coast, while more than 70 per cent of our power demands are in the northeastern part of the United States, and there is no practical way of bringing the two together. If all the water powers east of the Mississippi were developed, they would supply only about 40 per cent of the present-day requirements of the public utilities and manufacturing plants in this section. On the other hand, if all requirements of the Pacific Coast States were supplied from water power, only 20 per cent of their resources would be used.

While, therefore, it appears certain that fuel power will always be dominant in the eastern half of the country, and without much doubt for the country as a whole, there is still opportunity for a continued increase in water-power development, and all indications are that the rate of the last few years will be maintained. Since the great majority of the water-power developments will come under the jurisdiction of the Federal Power Commission, it will be the most important single governmental agency in the power field, for the fuel power field is distributed among 48 states.

The policies which the Commission pursues will have a marked effect on the power industry as a whole, and the practices it established in matters of regulation, while not controlling upon the states, are likely, nevertheless, to have an important influence.

It is planned to hold a World Engineering Congress in connection with the World's Fair Centennial to be held in Chicago in 1933. The Western Society of Engineers has been selected to take the leadership in the project.

Short-Center Belt Drives with Flexible Idlers

AT THE fourth regional meeting of the Power Transmission Association, held April 1 in Philadelphia, Roy C. Moore, chief engineer, Chas. A. Schieren Company, presented a paper "The Short Center Drive with the Flexible Idler." The following is an abstract of this paper, which gives suggestions for obtaining satisfactory service from this type of drive:

The short-center drive with a flexible idler is often referred to as a belt killer or short-life belt drive. An analysis of many of these drives shows that quite a number of them have a short belt life. Further examination of these drives reveals that they were a failure as an open drive, and the installation of the flexible idler was the only means whereby the belt could be forced to carry the load. Naturally, a drive of this type has a short belt life.

Advantages of Short Center Flexible Idler Drive

Many manufacturers have come to look upon the flexible idler, not as a desirable drive, but something to use when conditions will not permit the operation of an open belt drive. The short-center flexible-idler drive has many advantages often overlooked. For instance, this type of drive can be installed in a small space, automatically takes care of elongation in the belt for various loads, maintains a uniform tension in the slack strand regardless of conditions, makes it possible to transmit larger loads over small diameter pulleys and requires very little attention or maintenance for operation.

Perhaps the greatest number of failures of these drives is with installations where the small pulley is not large enough for the load which it must carry. By keeping a record of those drives that were a failure, it has been found that there is a minimum diameter pulley over which a given load may be transmitted on the basis of a normal belt rating as given by any standard engineering handbook. In those cases where the diameter of the pulley is less than this amount, the life of the belt is shorter and it is necessary to run the belt under greater tension to make it carry the load. The addition of a flexible idler increases the surface contact on the small pulley at least 25 per cent, thereby making it possible to use pulleys 25 per cent smaller in diameter than for open drives.

With the present high-value floor space, long center drives may prove expensive to operate and often lead engineers to the consideration of other mechanical-power transmission mediums. The installation of the short-center flexible-idler drives will confine the drive to the reduced space required and will automatically tension the belt under all loads.

The idler should always be placed as close as possible to the small-diameter pulley. On vertical drives it is sometimes desirable to counterweight the idler by means of cables operating over sheaves or pulleys to maintain the proper tension in the belt. When an idler is being placed on a compressor drive, there are occasions when the idler is attached to the compressor itself. It is best to set the motor up close to the idler so as to secure the maximum wrap on the motor pulley.

In an oil field where many compressors are operated in one room, the idlers that were a part of the original equipment were made with bronze bushings. Failure to keep these bushings properly lubricated caused rapid wear and misalignment. Of late, quite a number of these drives have been equipped with one of the standard flexible idlers, using anti-friction bearings. As a result they require little attention for long periods of time of operation.

With vertical drives any elongation due to load or stretch in the belt allows it to drop away from the lower pulley and materially decreases the pressure between the belt and the pulley, causing a corresponding decrease in the power-transmitting capacity of the belt.

Rule for Laying Out Vertical Drives

From the viewpoint of general practice we formulated a simple but practical rule in laying out vertical drives. This rule is to deduct one per cent from the rated capacity of the belt for each degree the drive makes with the horizontal above 40 deg. In other words, it has been found that belts operating at an angle of 40 deg. to the horizontal can transmit their rated capacity and still have a long life. Belts operating in a vertical position should not be called upon to transmit more than one-half as much power as belts operating at an angle of less than 40 deg. with the horizontal position. This applies to open belts. When a flexible idler is used, no allowance need be made for elongation in the belt, since any stretch is automatically taken care of by the idler.

In some of the older plants it has been found advisable to discontinue long mechanical drives and install a high-speed generator. The use of a flexible idler makes an economical arrangement, requires small floor space and permits the use of the steam engine formerly used for the other drives.

Flexible Idlers in Rock Plants Is Advantageous

In rock plants where a great deal of dust settles on the belt, the friction surface of the belt is greatly decreased. The use of flexible idlers is advantageous under these conditions, since they maintain a suitable tension in the belt at all times. This tension and the width of the belt are figured on a low coefficient of friction for the belt. As a result of maintaining proper tension, the belts seldom slide off the pulleys, as is so often true when they are run as a regular open drive.

When it is advantageous to drive two machines with one motor by using two belts, it is often difficult to keep both belts at the proper tension, particularly if only one machine is used at a time. The installation of flexible idlers will keep the belts at proper tension regardless of load variation or stretch in the belts.

When laying out a flexible-idler drive it is necessary that the tension in the tight side of the belt does not exceed a given amount if the belt is to render a normal life. All installations that we have observed, where the tension in the tight side is 350 lb. per sq.in. or over, the life of the belt has been short. It is desirable that the tension in a drive of this type never exceed 200 to 250 lb. per sq.in. to secure a normal life from the belt.

Employment Situation Satisfactory

EMPLOYMENT in the manufacturing industries of the United States at the beginning of the current year on the average was higher than it had been at any time since the second quarter of 1926, the "banner" year of manufacturing production in the post-war period up to 1928, with indication that the rising tendency is continuing, according to a recent statement by the National Industrial Conference Board, New York.

Further evidence of prevailing healthy economic conditions is the fact that wage earnings in the manufacturing industries for the last five years have shown remarkable stability, with a slightly increasing trend, while living costs during the same time showed a slight decline, further contributing to the improvement in the economic status of the American industrial worker. As a result, the purchasing power of average weekly earnings per worker—that is, the average "real weekly" earnings of workers in industry—at the beginning of the current year were nearly 6 per cent., and the average "real hourly" earnings per worker 5 per cent. greater than at the beginning of 1927.

Resumption of work on the Ontario Hydro-Electric Power Commission's 54,000-hp. power development at Alexander Landing, on the Nipigon River, is to take place immediately. This undertaking, which is scheduled for completion in 1931, is said to involve an expenditure of approximately $6,000,000 and is required to meet the growing demand for power on the Thunder Bay system. A feature of the Alexander Landing development will be the construction of an immense earth-filled dam, said to be the first of its kind in this part of Canada. The dam will be built across the bed of the river and will be filled with treated clay to make it leakproof.

Oil Situation Calls for Immediate Solution by Agreement of States

Industrial Consumers of Petroleum Products Can Help by Co-operating with Producers Is Opinion of Federal Authorities

By Paul Wooton
Washington Correspondent of Power

An opportunity to help straighten out one of the outstanding economic tangles of the day is offered industrial consumers of petroleum products, in the opinion of federal officials. They regard the oil industry as the outstanding offender against the fundamentals of conservation, in that appalling waste of resources and capital is resulting from a riotous rate of production carried on without regard for demand.

Overproduction is cited as the bane of agriculture, the bane of coal mining and the bane of many other extractive industries. Overproduction, it is said, would have wrecked the steel industry had not sheer necessity led to the creation of the United States Steel Corporation. Unrestrained competition, particularly when great masses of capital are engaged, often means bankruptcy for someone, with all its attendant demoralization. When natural resources are involved it frequently means waste of a most insidious kind.

Oil production is an activity in which great amounts of capital are at stake and in which the waste of the resource is proverbial. Under the existing property laws and court decisions the owner of oil rights must drill in self-defense as soon as his neighbor begins to take out oil. Otherwise his property melts away because of drainage underground.

Law of Supply and Demand Inoperative

Petroleum is the one commodity where the producer cannot operate with primary reference to demand. The law of supply and demand which the world accepts as the regulator of prices, in this case is not allowed to function. The quantity produced does not depend upon the plans or the desires of the operator, or upon his judgment as to what he can sell. As a result of the application to this migratory underground resource of the English common law applying to property and land economic chaos has developed.

The common law was developed on an agricultural island. Its principles have worked magnificently in the development of our agricultural resources, but when petroleum was discovered a mistake was made in trying to apply them to property in that form. When the courts tried to find common law precedents for the new problem, the only reference they could find to guide them was the application of the law to wild animals. Petroleum, they reasoned, was like a wild animal and should belong to the one who could capture it. This curious idea meant if an operator were to drill on his own land he could keep all the oil he could capture, but his neighbor had a perfect right to sink a well of his own and entice away as much as possible of the oil under the first operator's property.

The only sane way out of this tangle of conflicting property rights, say disinterested observers, is to require the owners of a given pool of oil to agree on some plan for the co-operative development of that pool. Then, and not until then, can they exercise the responsibility of all business men to conduct their production with some reference to the requirements of the market.

Co-operative Development Essential to Success

The oil industry finally has come to the realization that something in the character of co-operative, unitary development of oil pools must come. The industry, however, is powerless to require the adoption of the plan as long as one substantial interest refuses to go along with the program. The experiments with unit operation are promising, but they indicate that some kind of legal authority must exist to require the dissenting minority to accept the co-operative plan.

This legal authority can be granted by the states under their police powers, but jealousies between states and the competitive situation raise objections to that plan. If Oklahoma reduces production and Texas does not, for instance, the only beneficiary of the Oklahoma curtailment might be the Texas producers with flush pools there contributing to the oversupply, as is happening at present. The belief is that some means of controlling all such pools must be found. Otherwise, the curtailment by the operators in a single pool may be a useless sacrifice.

Cut-Throat Competition Prevails

The present situation in the oil industry is one of cut-throat competition, precipitated by a number of pools in Oklahoma, in Texas, in California and even in foreign countries. For more than a year prices have been ruinously low, operators contend. Oil has been flowing into storage at the rate of 2,000,000 barrels a week. Stocks are the largest on record. They are nearly three times as large, it is contended, as would be needed to give the consumer an absolute guarantee against an interruption of supply. It is the menace of further needless production that led the producing companies to meet and formulate a plan to produce no more oil than they did last year.

This program, they declare, carries no threat to the consumer. The requirements for gasoline, which increase at the rate of 11 per cent per year, can be met by cracking a greater proportion of the crude. Considering the present level of stocks of crude, the industry is said to be in a position to meet all possible demand for gasoline, even if much less crude is produced this year than was the case last year. In view of that situation it is believed that the producers well can afford to guarantee the consumer against any increase in price. It is believed that they will be rewarded amply if they can save further expense of storage and prevent further reductions in the price of crude.

In this connection the contention is made that American industries already have the advantages of the cheapest coal in the world and should not ask for fuel oil at less than the cost of production.

Administration Anxious to Encourage Waste Elimination

In spite of the verdict of Attorney General Mitchell that no department of the government has the authority to waive the Sherman law, it is apparent that the Administration is anxious to be able to encourage the elimination of waste in the oil industry. The President's announcement that oil on the public domain is to be conserved is interpreted by the industry to mean that the government sees no occasion for increasing the surplus already available.

The Interior Department is taking the lead by shutting in the production of the Kettleman Hills field. Even the public lands states that have relied upon federal oil royalties for revenue, in the opinion of some of their own representatives, have more to gain than to lose. They point out that any reduction in the number of barrels of royalty oil would be offset quickly if present prices of crude can be restored to a profitable level. The President has let it be known that the responsibility now rests with the oil-producing states. Dr. George Otis Smith, the Director of the United States Geological Survey, has been dispatched to these states to emphasize that they have the power under our constitutional system to enter into compacts to limit output temporarily or for definite periods and to make legal the restriction on production that are proposed.

The history of the Colorado River compact shows both possibilities and dangers in that direction. If the states will exercise their undoubted powers, the ends sought by the federal government can be obtained, but if one or two decline to ratify the compact, a deadlock is produced which can be overcome only by a long and tedious process.

There is a feeling among officials in Washington that there will be strong support for its oil policy among the consumers of fuel oil.

Events and Men in Power's Field

THE EDITORS WILL WELCOME THE CO-OPERATION OF READERS IN REPORTING INTERESTING HAPPENINGS, PERSONAL OR OTHERWISE

Welding Society Holds Annual Meeting

Llewellyn re-elected president—Miller Medals awarded to C. A. Adams and J. H. Edwards—Technical papers touch welding schools, structural steel, heating and ventilation, aviation, railroads and the chemical industries

RE-ELECTION of F. T. Llewellyn as president; presentation of Miller medals to Professor Adams and J. H. Edwards; five technical sessions showing welding developments in the structural, chemical, railway and aviation fields; dinners and luncheons—these were the principal features of the annual meeting of the American Welding Society held April 24-26 at the Engineering Societies Building, New York City. As is usual at these meetings, about equal attention was given to the electric and oxyacetylene process.

F. T. Llewellyn, the re-elected president, is connected with the United States Steel Corporation and has played an active part in the development of structural welding. A. E. Gaynor was re-elected senior vice-president. George Bird and J. S. Beall were elected vice-presidents representing, respectively, the Southern and Pacific Coast divisions. Directors at large were elected as follows: C. A. Adams, H. M. Hobart, A. G. Oehler and J. W. Owens.

Presentations of the Samuel Wylie Miller gold medal for 1927 and 1928 gained special interest from the fact that Mr. Miller, the donor of the medal, did not live to see the presentation, although he had personally approved both selections. Mr. Miller, consulting engineer of the Union Carbide & Carbon laboratory and a pioneer worker in the welding field, established this medal to be awarded yearly during his lifetime for meritorious achievement contributing conspicuously to the advancement of the art of cutting and welding by the gas or electric processes.

Comfort A. Adams, professor of electrical engineering at Harvard, first president of the American Welding Society and continuously director of its Bureau of Welding, also past-president of the A.I.E.E., was awarded the first (1927) medal in recognition of his distinguished services to the industry. In accepting the medal, Professor Adams paid tribute to Mr. Miller, characterizing him as a "straight shooter" and "the ablest all-around expert in the field of fusion welding." The 1928 Miller medal was presented to James Harvey Edwards, chief engineer of the American Bridge Company, for his work on the welding of steel structures. Mr. Edwards is chairman of the Society's Structural Steel Research Committee.

At the suggestion of F. M. Farmer, past-president and chairman of the Medal Committee, the meeting unanimously recommended to the Board of Directors that the medal be continued in perpetuity as a memorial to its founder and original donor.

The opening technical session on Wednesday morning was devoted to a symposium on "How to Organize and Direct an Industrial Welding School." In this, prepared papers were presented by C. E. Conway, Bedford Branch (New York) Y.M.C.A.; R. K. Randall, Cleveland Welding School; L. S. Thurston, General Electric Company; F. E. Sellman, Servel, Inc.; F. E. Rogers, Air Reduction Sales Company; R. B. Lincoln, Westinghouse Electric & Manufacturing Company; J. C. Lincoln, Lincoln Electric Company and M. R. Bass, the William Hood Dunwoody Industrial Institute (Minneapolis).

It was agreed by all the speakers that adequate provision for the training and qualification of welders is one of the major needs of the welding industry. Large users of welding equipment have found it worth while to set up their own schools. Some manufacturers of welding equipment maintain schools for the benefit of customers. Many of the smaller users of welding are co-operating with local industrial schools which give picked men a preliminary training in welding technique.

It was pointed out that steamfitters are generally anxious to develop skill in welding, as they can thereby increase their pay by a dollar a day or more.

Mr. Bass pointed out in his paper that Dunwoody Institute has trained more than 1,400 workmen in welding since it started welding instruction.

R. K. Randall, of the Cleveland Welding School, felt that eighty hours of practice under competent instructors should enable the average intelligent mechanic to hold down a job as a welder. Honesty was listed by F. E. Rogers as an essential qualification of the prospective welder.

In the discussion J. W. Owens stressed the point that uniform courses in welding are not practicable on account of the varied requirements of different types of welding work. He said that men in the shipyards are supposed to have at least seventy lessons before starting commercial work.

Closing the discussion, H. S. Card, editor of the *Welding Engineer*, said that welding schools have grown much better in the last two or three years. He agreed that something might be done by local sections of the A.W.S. in the matter of certificating welders. In teaching, he felt, much emphasis should be placed on checkup and review.

A paper on the "Strength of Butt Welds," was presented in the afternoon technical session by G. Lobo, Jr., of the Westinghouse Electric & Manufacturing Company. Mr. Lobo's conclusion that the single "V" 45-deg. bevel (90-deg. "V") generally gives the strongest weld, was questioned by several who felt that the experience of the industry shows 30-deg. bevel to be better. Discussion of this paper also brought out the fact that interesting tests showing the concentration of stresses around welds are in progress at the Massachusetts Institute of Technology and the University of Pittsburgh.

Other papers on Thursday dealt with applications of welding to the construction of steel structures, the heating and ventilating industry, to aircraft and rail joints.

In the Friday morning symposium on

Men in the News

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D. ROBERT YARNALL

was elected president of the Philadelphia Engineers Club on April 16. He is a member of the Franklin Institute, Sigma Xi and chairman of the committee on relations with colleges of the A.S.M.E. In 1911 Mr. Yarnall with B. G. Waring organized the Yarnall-Waring Company to manufacture power-plant devices. He holds a number of patents on inventions relating to the valve and steam specialty field.

welding in the chemical and process industries, W. M. Dunlap, of the Aluminum Company of America, discussed aluminum welding; N. B. Pilling, of the International Nickel Company, showed how ductile welds can be produced in nickel and Monel metal; "Welding of Pressure Vessels for High Pressures and Temperatures," was discussed by T. McLean Jasper, of the A. O. Smith Corporation; P. D. Schenck gave a paper on the welding of Duriron.

Friday afternoon was devoted to the annual meeting of the American Bureau of Welding, wherein research activities were discussed, and a meeting of the Structural Steel Welding Committee.

Social features of the meeting included a luncheon at the Engineers Club and a dinner with special entertainment at the Hotel Pennsylvania on Thursday.

60,000-Kw. Plant for Sayreville, N. J.

At Sayreville, N. J., on a site adjoining the main channel of the Raritan River, ground has been broken for the erection of a new power plant to be operated by the New Jersey Power Company, a subsidiary of the Utility Power & Light Corporation, having headquarters in Chicago. The initial installation will be 60,000 kw. in two 30,000-kw. units, and this capacity will be increased to 180,000 kw. as the demand for power in eastern and central New Jersey justifies the expansion.

Steam at 400 lb. pressure and a total temperature of 700 deg. F. will be generated by four 12,000 sq.ft. boilers, stoker fired and equipped with air preheaters, economizers, forced- and induced-draft fans. The general contractor on the new work is the Management & Engineering Corporation, a subsidiary organization which does all the construction work for the holding company. It is anticipated that the plant will be ready for operation by April 1, 1930.

World Power Conference to Be Held at Barcelona

Two sectional meetings of the World Power Conference are to be held during 1929—one in conjunction with the Barcelona Exposition, May 15-23, the other at Tokyo the end of October. Plans for the latter have already been announced in these columns.

The first Plenary World Power Conference was held at Wembley, England, in 1924, at which the whole field of power was considered, including production and utilization. At Barcelona, however, the attention of the meeting will be focused on the complete utilization of water-power resources. Papers will be presented under five headings: General hydro problems, technical problems of water power utilization, economic and financial problems, and protective measures for undertakings.

Spot * News

PRESIDENT HOOVER *has designated James W. Good, the Secretary of War, to be chairman of the Federal Power Commission. Under the water power act the President must appoint as chairman one of the three secretaries comprising the Commission. In view of the fact that Secretary Wilbur, of the Department of the Interior, had previously had some contact with the water power situation, there had been some belief that the chairmanship of the commission might go to him.*

* * *

THE STATE OF OHIO *has just adopted the A.S.M.E. Code for Unfired Pressure Vessels to become effective after July 1, 1929. Paragraphs U-1, U-23 and U-68 were revised to suit the needs of the division of boiler inspection, at Columbus, according to C. O. Myers, chief of the division.*

* * *

THE TOTAL ENERGY PRODUCTION *of the world in 1928 was 52,383 trillion B.t.u., according to a report of the Department of Commerce. This figure includes energy produced from coal, lignite, oil, natural gas and water power which was represented by the equivalent in B.t.u. of the fuel necessary to perform the same work.*

* * *

BY A VOTE OF 2,656 TO 1,856 *the citizens of Santa Cruz, Calif., on April 16, rejected the proposition of the People's Construction Company of San Francisco to build a power plant on the San Lorenzo River and transmit power to the city to be distributed by the municipality. Under the plans proposed the city would have entered into a contract to buy electric energy for a period of forty years, at the end of which the plant would have reverted to the city.*

* * *

NEW ORDERS *for 1,466 steel boilers were placed in March, as reported to the Department of Commerce by 81 manufacturers, comprising the leading firms in the industry, as compared with 1,028 in February and 1,462 in March, 1928.*

* * *

THE AMERICAN SOCIETY OF CIVIL ENGINEERS *has just been admitted to membership in the American Engineering Council. The A.S.C.E. has a membership of 13,577, and becomes associated with six other national engineering societies—the A.I.E.E., A.S.M.E. and associations of consulting, industrial, chemical and agricultural engineers.*

* * *

WHEN COMPLETED, *the new steam plant now being constructed by the El Paso Electric Company, will have a total capacity of 40,000 kw. A new 25,000-kw. unit is being installed, and a 15,000-kw. unit will be removed from the present power plant, which will be used for stand-by service when the new plant is finished.*

Date for Southern Textile Exposition Announced

The date for the ninth Southern Textile Exposition has been set for Oct. 20-25, 1930, at Greenville, S. C. This was announced at Textile Hall recently. Among the largest exhibitors will be Barber-Colman Company, H. W. Butterworth & Sons Company, Curtis & Marble Machine Company, Cocker Machine & Foundry Company, Davis & Furber Machine Company, Draper Corporation, General Electric Company, Howard Brothers Manufacturing Company, B. F. Perkins & Sons Company, Philadelphia Drying Machine Company and Westinghouse Electric & Manufacturing Company. Many others equally well known have reserved space.

The balcony of Textile Hall will be enlarged by an extension at the north end. It is proposed to move the elevator to a new separate shaft and thereby provide for a continuous promenade around and over the stage. This will provide additional exhibition booths and greatly increase the desirability of balcony space. The alterations will be made this summer.

London Diesel Engine Users Association Meets

At a well attended meeting of the Diesel Engine Users Association held in London recently, H. O. Farmer read a paper entitled "Some Notes on High-Speed Oil Engines." Confining the discussion to the four-stroke-cycle engine, the author said the interest shown in a high-speed Diesel engine of good performance was largely on the grounds of the great saving of fuel cost.

In his opening remarks Mr. Farmer said that there appeared to be an increasing demand for a high-speed compression-ignition oil engine to take the place of the low-compression carbureter engine which was in use over such a wide field. The characteristics of the oil-engine were well known, but the problems in its development to meet the high standards of performance set up by the gasoline engine presented many difficulties.

The author remarked that it was interesting to note that at one end of the scale there was the large Diesel engine, where the limiting factor was that of conducting away the heat, requiring a water-cooled piston and great attention to heat stresses, while at the other end of the scale there was the small high-speed engine with its exceptionally high compression ratio. An extreme example was the primitive method of obtaining power by ramming a close fitting plunger down a tube containing a tinder at the end.

To obtain the highest thermal efficiency, constant volume combustion would be aimed at. This would mean that for a compression ratio of 14 to 1 and a brake mean pressure of 80 lb. per sq.in., the maximum gas pressures

would be about 1,200 lb. per sq.in. This was not permissible on mechanical grounds; in fact, the lower the maximum pressures the better. To obtain a smooth-running engine the rate of pressure rise should not exceed some 40 lb. per sq.in. per degree.

As an example of the application of a high-speed oil engine some details were given of an engine developed for use on the road. It was considered that the work of a bus would constitute the most severe test and, together with continuous running under load on the test bench, would soon show up any deficiencies. Information was afforded regarding the particular engine which had been designed as suitable for use in a standard four- to five-ton chassis requiring an output of 45 hp. at 1,000 r.p.m. Figures for fuel consumption which were quoted by the author had been obtained with a standard light Diesel fuel of 0.89 specific gravity; the start of injection had been fixed, and the maximum gas pressures had been limited to 800 lb. per sq.in. under any conditions. Under normal road conditions the pressures did not exceed 750 lb. per square inch.

Large Number of Engineers Holding Public Office

A recent canvass by the American Engineering Council disclosed a surprising number of engineers holding responsible positions in the political life of the nation. The study covers a canvass of governors of all states and members of the Senate and House of Representatives.

Besides the engineer in the Chief Executive's chair, President Herbert Hoover, a member of the American Society of Mechanical Engineers, those listed are divided into three classes: First, those who are or were at the time of their election to public office, professional engineers both by training and experience; the second group comprises those who have been engaged in work which is essentially engineering and which requires the engineering mode of thinking and method of approach. The third group is of those who received their basic training and education in engineering, those who received a Bachelor of Science degree in an engineering school, but have subsequently taken up other fields of activity.

In the first group there are ex-Vice-President Dawes, five governors, two ex-governors, five senators and five members of the House of Representatives. The second group embraces one governor and five representatives; while the third group has in it three governors and eleven representatives.

From this survey there would seem to be a decidedly increasing tendency on the part of the public to trust men of engineering training with public office. In 1920 there were but two governors, two senators and nine representatives from all three classes holding office.

Newcomen Society Unveils Tablet on Grave of Josiah Hornblower

ONE little steam engine, with a fuel-fired boiler, erected in this country in 1753, laid the foundation of America's mechanical age. Billions of tons of power exerted in moving the machinery of this productive nation have followed this first little power plant set up in what is now North Arlington, N. J., by Josiah Hornblower. To perpetuate his memory, the American members of the Newcomen Society of England unveiled on Wednesday afternoon, April 24, a bronze tablet on his grave in the churchyard of the Dutch Reformed church, Belleville, N. Y. Pictures of the tablet and grave are shown in the accompanying cut.

Dr. Fred R. Low, American member of the Newcomen Society and editor of *Power*, spoke at the unveiling ceremony. In part, he said, "In the early 1700's Thomas Newcomen, an ironmonger of Devonshire, evolved from the attempts of Papin, Savary, and others a steam engine that came into extensive use in England and Wales for pumping purposes. It was this engine that, improved by Watt and adapted to the driving of machinery, laid the foundation of this mechanical age.

"In 1753, while James Watt was in his teens, Josiah Hornblower, whose memory we are assembled to perpetuate, brought to America, to pump a copper mine on the Schuyler estate near what is now the corner of Schuyler and Belleville Avenues in North Arlington, one of these Newcomen engines, the first steam power plant to be erected on this side of the Atlantic.

"Only one who knows how essential a part power by steam plays in the present social and economical structure and who can visualize conditions as they existed before Josiah Hornblower brought this plant to and operated it in America can realize the significance of this initial installation and the interest that clusters about the record of Hornblower's work, these scenes of his activities, and his last resting place. In the little over a century since his remains were interred at this spot, the fires that he lighted beneath his boiler have spread from coast to coast and from lake to gulf, energizing our industries, transporting our products and shifting the burden of arduous labor from human muscle to swift and tireless machinery.

"Josiah Hornblower was not only the first American steam engineer; he became a prominent citizen of New Jersey and held many honorable offices in the public service. . . .

"The Newcomen Society of Great Britain is founded to preserve the history of the mechanical arts. The American section of this Society has considered the direction of public attention to this spot and to the life and achievements of Josiah Hornblower as a privilage consistent with its objects and purposes. . . ."

Following the unveiling ceremony at Belleville, the Newcomen Society members returned to the Engineers Club in New York, where the fifth annual dinner and meeting was held concurrently with the meeting in London of the parent society. The program included a paper on "The First Steam Engine in America," by L. F. Loree, president of the Delaware & Hudson Railroad, the first to operate in America; a paper on "The Evolution of the Writing Machine," by John H. Barr, vice-president of the Barr-Morse Corporation, Ithaca, N. Y., and a member of the A.S.M.E.; slides and a paper on "The Rainhill Locomotive Trails of 1829," by C. F. Dendy-Marshall, London, which was also presented at the meeting in England.

Changes in Iowa Plant

Installation of two new 600-hp., a 500-hp. and resetting of one of the present 500-hp. boiler units at the Iowa Southern Utilities Company's power plant in Ottumwa, Iowa, will be under way in a few weeks, H. F. Darbyshire, manager, has announced. The improvements will call for an expenditure of $300,000 and will double the power units in the plant to 4,400 hp. The present L shaped building will be squared to provide for the new units which will be erected opposite the present battery of five boilers that will continue in operation during the expansion. A coal bunker of 500-ton capacity, a weigh hopper, automatic colliery and economizer in the smokestack with special draft to draw the gases into the economizer are other features of the modern equipment installation included in the plant. The boilers will be of the water-tube, underfeed type.

Increased efficiency of operation and greater plant economy will be the object of the installations, officials said. The plant is now providing electric service for 12 southeastern Iowa communities.

Special Research Committee Authorized by A.S.M.E.

The Council of the American Society of Mechanical Engineers has authorized the appointment of a special research committee on Slagging and Removal of Coal Ash in Boiler Furnaces. The purpose is to investigate the adding of fluxes as a means of increasing the fluidity of slag in boiler furnaces and thus permit its removal at operating furnace temperatures.

A number of prominent engineers from public utilities, the Bureau of Mines and power-plant designing and construction companies have agreed to serve on a committee to conduct such an investigation.

Canadian System Installs Electric Steam Boiler

The Hydro-Electric System of Toronto, Ontario, recently installed a 1,000-kw. electric steam boiler for heating service in its Scott Street buildings. This site was formerly occupied by the Toronto Electric Light Company and when its assets were taken over by the Hydro Electric Power Commission and the Toronto Hydro-Electric System, the latter obtained possession of the direct-current substation, stand-by battery, machine shop and other buildings now used for transformer testing, etc. The Provincial Commission retained the steam plant, later transferring it to the Toronto Terminals Railway Company, on the commencement of a new railway viaduct across the water-front. As steam for heating all the buildings on this site was obtained from the boilers of the stand-by steam plant, on the demolition of this plant another supply became necessary.

Coming Conventions

American Boiler Manufacturers Association. Annual meeting, June 3-5, Sky Top Lodge, Cresco, Pa. A. C. Baker, secretary, 801 Rockefeller Blvd., Cleveland, O.

American Institute of Electrical Engineers, annual summer convention, Swampscott, Mass., June 24-28. Pacific Coast Regional Meeting, Santa Monica, Calif. Sept. 3-6. F. L. Hutchinson, secretary, 33 West 39th St., New York City. Regional Meeting, May 7-9, at Dallas, Texas. Secretary, A. E. Allen.

American Institute of Refrigeration, at Washington, May 2, 3, 1929. Louis Baron, secretary, 203 West 13th St., New York City.

American Society of Heating and Ventilating Engineers, annual summer meeting, Bigwin Inn, Lake of Bays, Ontario, Can., June 26-28. A. V. Hutchinson, secretary, 29 W. 39th St., New York City.

American Society of Mechanical Engineers, spring meeting, Salt Lake City, Utah, July 1-4, 1929. Rochester regional spring meeting, Rochester, N. Y., week of May 13. Calvin Rice, secretary, 29 West 39th St., New York City.

American Society for Testing Materials. Annual meeting, June 24-28, at Chalfonte-Haddon Hall, Atlantic City, N. J. Secretary, C. L. Warwick, 1315 Spruce St., Philadelphia, Pa.

Association of Iron and Steel Electrical Engineers, 25th annual convention, Pittsburgh, Pa., June 17-22, 1929. A. A. Stewart, secretary, Pittsburgh Steel Co., Monnessen, Pa.

Canadian Electrical Association, annual convention, to be held June 19-21, at St. Andrews-by-the-Sea, N. B. H. M. Lyster, secretary, Power Building, Montreal, Que.

Master Boiler Makers Association, at Atlanta, Ga., May 21-24. H. D. Vought, secretary, 26 Cortlandt St., New York City.

National Association of Power Engineers, 47th annual convention, Chattanooga, Tenn., Sept. 9-13. Fred Raven, secretary, 417 South Dearborn St., Chicago, Ill. N. J. State Association annual meeting, June 1-2, at Eagles Hall, Elizabeth, N. J. Conn. State Association annual meeting, June 14-15, at the Stratfield Hotel, Bridgeport, Conn. New England States Association annual meeting, June 20-21, at Fitchburg, Mass.

National Board of Boiler and Pressure Vessel Inspectors. Annual meeting, June 18-20, at Detroit, Mich. Secretary, C. O. Myers, 14 Commercial Nat'l Bank Bldg., Columbus, Ohio.

National Electric Light Association. Annual meeting at Atlantic City, N. J., June 3-7. A. J. Marshall, secretary, 420 Lexington Ave., New York City.

National Exposition of Power and Mechanical Engineering, Grand Central Palace, New York City, Dec. 2-7. Charles F. Roth, manager, Grand Central Palace, New York City.

National Oil and Gas Power Meeting. Under auspices of A.S.M.E. Oil and Gas Power Division and the Pennsylvania State College. June 24-27, State College, Pa. F. G. Hechler, chairman, State College, Pa.

Northwest Electric Light and Power Association. 22nd Annual Convention, June 26-29, 1929, at Seattle, Wash. Registration and information: J. J. Hayes, Westinghouse Electric & Manufacturing Company, Seattle, Wash.

World Engineering Conference, Tokyo, Japan, October, 1929. All correspondence should be addressed to the Secretary, World Engineering Conference, Nikon, Kogyo Club, Morunouchi, Tokyo.

A.S.M.E. Metropolitan Section Hears About the Crankless Engine

The crankless engine, in which the motion of the pistons is parallel to the shaft, was the subject of a meeting of the Metropolitan Section of the A.S.M.E. A. G. M. Michell, President of the Michell Crankless Engine Corporation, New York, was the speaker of the evening.

Mr. Michell first explained the general fundamentals of this mechanism and then showed cross-sections of three typical engines using this method of transforming reciprocating motion to rotation. In all these types the reciprocating motion is transmitted to a disk that is keyed to a straight shaft at an angle of about 22 deg. The difference between them lies in the method of connecting the disk and the pistons.

In the Michell engine the pistons and cylinders are arranged by pairs in tandem around a central shaft. Each pair of pistons are fastened together at their circumference farthest from the shaft. Slippers similar to those used in a Kingsbury thrust bearing, are held in a spherical shaped cup formed in the bottom of the piston and bear against the revolving disk, or slant, as it is called.

The success of such a mechanism depends upon the possibility of the relative sliding motion of the slant and the slippers, taking place with a minimum amount of friction. This has been accomplished by locating the ball unsymmetrically with respect to the opposed flat face to the extent of about one tenth of the length of the face in the direction of the relative sliding motion of the slant. The slipper is thus enabled to function in the same way as the pads of the pivoted-type thrust bearing, known as the Kingsbury. With such provision experience shows that the coefficient of sliding friction can be extremely low, 0.0015 or 0.002 being quite usual values. As a result it is claimed that the mechanism is enabled to operate with quite high efficiency and with practically the same efficiency whether utilized as a motor or as a pump.

The symmetrical location of the cylinders and pistons around the shaft, it is claimed, makes possible a more perfect dynamic balance than is possible with the ordinary crank engine. This is one of the chief advantages claimed for this engine. Among others are the fewer bearings necessary and the more uniform wear that takes place between piston and cylinder.

The particular fields in which Mr. Michell believes his engine would be found applicable are in the internal combustion engine for such uses as Diesel locomotives, Diesel airplane engine, and automobile engines. At present the crankless mechanism is being used successfully in compressors that are required to deliver large volumes of air or gas at moderate pressures. Several installa-

tion pictures of this type were shown.

In discussing the paper Mr. Kingsbury pointed out that the slippers on this engine can be successfully loaded to 1,000 lb. per sq.in. at relative speeds of 200 ft. per sec. Complete dynamic balance is secured by making the slant of proper thickness. A. E. R. de Jong, of the New York Edison Company, demonstrated that according to kinematics the so-called crankless engine employs a special form of the crank mechanism that produces true harmonic motion.

PERSONALS

JOHN E. STARR, first president of the American Society of Refrigerating Engineers, was tendered a complimentary luncheon at the Engineers Club, New York City, on Saturday, April 13, at which honorary membership in the society was conferred upon him. He is the first to receive this honor. Addresses were made by Peter Neff and Dr. W. S. Jacobus.

C. A. HEINZE, formerly with the Los Angeles Bureau of Power & Light, has been appointed assistant chief engineer and general manager of the Department of Water and Power, following the recent reorganization.

J. W. MORTON has become associated with the Du Pont Engineering Company, of Wilmington, Del. He was formerly with the American Brown Boveri Company.

W. C. HECKEROTH, chief engineer of the Erie City Iron Works, Erie, Pa., for more than 25 years, has been appointed sales manager of the Fuel Efficiency Corporation, Birmingham, Ala.

M. L. HIBBARD has succeeded W. R. Putnam as president and general manager of the Idaho Power Company. Mr. Putnam has resigned to join the Electric Bond & Share Company.

C. R. STEWART is now with Stone & Webster Engineering Corporation at Boston, as engineer in the machinical division. His former position was with the Raritan Copper Works as assistant to the consulting and power engineers.

BUSINESS NOTES

I. P. MORRIS and DE LA VERGNE, INC., has moved its New York office from 100 Broadway to 33 Rector St.

INDUSTRIAL BROWNHOIST CORPORATION announces the removal of its Pittsburgh office from the Oliver Building to the new Koppers Building. Mr. Kleinhans will continue in charge.

THE READING IRON COMPANY recently held its annual stockholders' and directors' meeting, at which L. E. Thomas was elected president, J. H. Callen, P. N. Guthrie and R. J. Wenger, vice-presidents; G. W. Delaney, secretary, and H. N. Yost, treasurer.

THE AMERICAN ENGINEERING COMPANY, Stoker Division, is moving from 100 Broadway to 40 West 40th St., New York City.

THE WORTHINGTON PUMP & MACHINERY CORPORATION has transferred W. J. Denholm from its Chicago office to the post of assistant to the manager at the Harrison Works, Harrison, N. J.

With the Society Sections

A. S. M. E., Boston Section. Meeting May 15 at Engineers' Club. Subject: "Pulverized Fuel Systems," by Henry Kreisinger, research engineer, Combustion Engineering Corporation.

A.S.M.E., Chicago Section. Annual meeting May 7 at Palmer House. Elmer Sperry, president of the A. S. M. E., will address the Chicago members.

American Engineering Council. Meeting May 24-25, at Washington, D. C., of Administrative Board.

American Water Works Association, Illinois Section. Meeting May 13-14 at the Clayton Hotel, Waukegan, Ill. Secretary, M. L. Enger, Professor of Mechanics and Hydraulics, University of Illinois, Urbana, Ill. Minnesota Section. Meeting with the Minnesota League of Municipalities, June 12-14, at Austin, Minn. Secretary, R. M. Finch, Wallace & Tiernan Company, 240 South Fourth St., Minneapolis, Minn. New York Section. Meeting May 2-3 at the Mark Twain Hotel, Elmira, N. Y. Secretary, E. D. Case, The Pitometer Company, 50 Church St., New York, N. Y. Pacific Northwest Section. Meeting May 15-16 at Spokane, Wash. Secretary, Kenneth Shibley, 1005 Securities Building, Seattle, Wash.

TRADE CATALOGS

PIPING—"Engineering Data on Pipe Fabrication" is the title of a 100-page loose-leaf book recently issued by the Grinnell Company, Providence, R. I. The sheet size is 8½x11 in. The data included are drawn from such sources as the A.S.M.E., A.S.T.M., Power Piping Society and from the experience of the Grinnell Company. Pressures up to 1,400 lb. are covered.

UNDERFEED STOKERS — The Combustion Engineering Corporation, 200 Madison Ave., New York City, has made up an attractive 14-page descriptive booklet, MR-1, on multiple-retort stokers. There are two set ups, photographs of complete installations and other more detailed illustrations.

SWITCHES AND STOKERS—The Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., has recently put out two new leaflets of four pages each. The first, No. A-05793, is on multiple-retort underfeed stokers, and the second, A-05772, takes up disconnecting switches. They are both illustrated.

TRANSFORMER OIL — An eight-page bulletin, No. 162, discussing the purposes, properties and storing of transformer oil, methods of testing and precautions when handling, has been issued by the Wagner Electric Corporation of St. Louis, Mo.

FURNACES — The Erie City Iron Works, Erie, Pa., and the Carborundum Company, of Niagara Falls, have put out a bulletin on the new silicon-carbide lined Seymour furnace. There are photographs of interiors of furnaces and of installations, as well as line drawings showing construction. There are eight pages, and it is designated as SB7-5M-12-28.

ELECTRIC VALVES—Bulletin No. 100 on electrically operated valves of the solenoid magnet type, has recently been issued by the Electric Valve Manufacturing Company, 68 Murray St., New York City.

FUEL PRICES

COAL

The following table shows the trend of the spot steam market in various coals, f.o.b. mines; mine run, except Pittsburgh gas slack:

Bituminous (Net Tons)	Market Quoting	Price per Ton
Navy Standard	New York	$2.20@$2.55
Kanawha	Columbus	1.25@ 1.50
Smokeless	Cincinnati	1.85@ 2.00
Smokeless	Chicago	1.65@ 2.25
S. E Kentucky	Chicago	1.35@ 1.65
Steam	Pittsburgh	1.40@ 1.75
Gas Slack	Pittsburgh	1.00@ 1.20
Big Seam	Birmingham	1.25@ 1.50
Anthracite (Gross Tons)		
Buckwheat	New York	$2.50@$3.25
Barley	New York	1.40@ 1.75

FUEL OIL

New York—Apr. 25, f.o.b. Bayonne, N. J., 28@34 deg., Baumé, industrial use, tank-car lots, 5c. per gal.; 36@40 deg., furnace, tank-car lots, 6c. per gal.

St. Louis—Apr. 17, tank-car lots, f.o.b. St. Louis, 24@26 deg., $1.40 per bbl. or 42 gal.; 26@28 deg., $1.45 per bbl.; 28@30 deg., $1.50 per bbl.; 30@32 deg., $1.55 per bbl.; 32@36 deg., gas oil, 4.5c. per gal.; 38@40 deg., distillate, 5c.

Pittsburgh—Apr. 16, f.o.b. local refinery, 30@34 deg., fuel oil, 5c. per gal.; 36@40 deg., 5.5c. per gal.

Philadelphia—Apr. 17, 13@19 deg., $1.05@$1.10 per bbl. or 42 gal.; 22 deg. plus, $1.66@$1.71 per bbl.; 23@27 deg., $2.10@$2.15 per bbl.

Cincinnati—Apr. 23, tank-car lots, f.o.b. local refinery, 24@26 deg. Baumé, 5c. per gal.; 26@30 deg., 5.5c. per gal.; 30@32 deg., 5.95c. per gal.

Chicago—Apr. 19, tank-car lots, f.o.b, Oklahoma, freight to Chicago, 90c. per bbl. or 42 gal.; 22@26 deg., 65c. per bbl.; 26@30 deg., 75c. per bbl.; 30@32 deg., $1.15 per bbl.

Boston—Apr. 22, tank-car lots, f.o.b. 12@14 deg. Baumé, 4.55c. per gal.; 28@32 deg., 5.65c. per gal.

Dallas—Apr. 20, f.o.b. local refinery, 26@30 deg., $1.30 per bbl. or 42 gallons.

New Plant Construction

COMPILED BY THE MCGRAW-HILL BUSINESS NEWS DEPARTMENT, WHICH IS PREPARED TO FURNISH A MORE COMPLETE DAILY SERVICE TO THOSE WHO WISH IT

Ala., Birmingham—City, A. J. Hawkins, Engr., will soon award contract for the construction of a sewage system including pump house, pumping equipment, etc.

Calif., Sacramento—Pacific Gas & Electric Co., 11th and K. Sts., is having plans prepared for the construction of an electric power sub-station and equipment in Fruit Ridge Dist. Estimated cost $110,000.

Ind., Knightstown—Indiana Soldiers & Sailors Orphans Home, L. A. Cortner, Supt., plans the construction of a power house. Estimated cost $200,000. McGuire & Shook, 941 North Meridian St., Indianapolis, are architects.

Ia., Davenport—Bd. of Education, received lowest bid for the construction of a group of school buildings including heating plant, etc. from W. M. Allen & Co., Peoria, Ill. Estimated cost $450,000. Clausen, Kruse & Klein, 907 Kahl Bldg., are architects.

Ia., Spirit Lake—Iowa Public Service Co., awarded contract for the construction of a power plant, cooling tower, etc. to Zitterell-Mills Co., Webster City. Estimated cost $30,000.

Mass., Lowell—Everpure Ice Co., E. B. Eames, Gregg Bldg., Lawrence, is receiving bids for the consruction of an artificial ice plant on Aiken St. J. R. Worcester Co., 79 Milk St., Boston, is engineer.

Mass., Lowell—Daniel Gage Ice Co., Inc., D. L. Lyons, Pres., awarded contract for the construction of an artificial ice plant on Pawtucket St. to F. S. Moloy, 621 Wymans Exchange Pl. Estimated cost $60,000.

Miss., Clarksdale—Bd. of Education, H. B. Heidelberg, Supt., will receive bids until May 23 for the construction of a school including central heating plant. Estimated cost $225,000. P. J. Krouse, 505 M. & W. Bldg., Meridian. Gardner & Howe, Porter Bldg., Memphis, Tenn., are engineers.

Miss., Durant—City, L. J. Wilkes, Clk., will receive bids until May 7 for the construction of an 8 in. deep well connection with waterworks pumping station.

Mo., Bagnell — Union Electric Light & Power Co., L. H. Eagan, Pres., 315 West 12th Blvd., St. Louis, awarded contract for the construction of a hydro-electric development on the Osage river near here, initial capacity 60,000 hp., ultimate total capacity 215,000 hp. Plans include power plant and dam, 2,500 ft. long and 100 ft. high, sub-stations and transmission lines, etc. to Stone & Webster Engineering Corp., 120 Broadway, New York, N. Y. Estimated cost approximately $30,000,000.

N. J., Montclair—Public Service Production Co., 80 Park Pl., Newark, will build a power plant at 60 Valley Rd. here. Estimated cost $40,000. Public Service Electric & Gas Co., 80 Park Pl., Newark, is architect.

N. Y., Thiells—Dept. of Mental Hygiene, Albany, will receive bids until May 8, for addition to power plant for Letchworth village here.

Okla., White Eagle — Oklahoma Gas & Electric Co., Insurance Bldg., Oklahoma City, awarded contract for the construction of a steam generating station on Arkansas River near here to include turbine room, boiler room, etc. to Byllesby Engineering & Management Corp., 231 South La Salle St., Chicago, Ill. Estimated cost $2,343,361.

Tex., Dallas—City Commission, awarded contract for the construction of central pumping plant at Bachman's station to T. F. Larkin & Co. Estimated cost $270,767.

Wash., Centralia — City has been authorized to construct a hydro-electric power plant on the Nisqually river, near here 11,000 hp. capacity. The water supply will be conveyed 9½ miles in an open canal, 600 c.f.s., delivered through a penstock 975 ft. long to the turbines under 208 ft. effective head. Estimated cost $1,000,000. W. J. Roberts, is chief engineer. G. Dunbar, Elect. Engr. and R. F. Bullard, Asst. Engr.

Wash., Tacoma—City awarded contract for the construction of a new dam 240 ft. high near Potlatch on Hoods Canal in connection with Cushman power project unit No. 2, to L. H. Hoffman, U. S. Bank Bldg., Portland, Ore. Estimated cost $440,547.

Equipment Wanted

Boiler Room Equipment — County of Santa Clara, San Jose, Calif., H. Pfister, Clk., will receive bids until May 6, for furnishing and installing mechanical equipment in boiler room, at county hospital.

Condenser, Etc.—M. Y. Fieldhouse, Consulting Engr., Henderson, Ky., plans the installation of a 2000 kw. turbo-generator condenser with auxiliaries, switchboard and equipment.

Engines, Pumps, Etc.—Oregon Mercury Co., E. E. Morrison, Pres. and Gen. Mgr., Roseburg, Ore., plans the installation of engines, pumps, etc. for Burna Vista mercury mines.

Engines, Pumps, etc. — Palmdale Irrigation Dist., R. M. Coffin, Secy., Palmdale, Calif., will receive bids until May 4, for furnishing and installing one 100 and one 50 hp. Diesel engines, one 375 and one 315 g.p.m. turbine pumps, etc. for proposed waterworks.

Generator Unit, Boiler, Etc.—City of Watertown, S. D., will receive bids until May 10 for furnishing and installing electric lighting plant equipment to include new generator unit, boilers, stoker, etc. Estimated cost $125,000.

Ice Plant Equipment—Sarnia Arena Co., Sarnia, Cnt., prices on complete equipment for proposed artificial ice plant. Estimated cost $100,000. L. LeSueur, is interested.

Power Units—Signal Supply Officer, New York General Depot, 58th and First Sts., Brooklyn, N. Y., will receive bids until May 21, for thirty-seven power units.

Pump—City of Wilmington, N. C., plans the installation of a 5 m.g.p.m. pump, etc. for proposed waterworks improvements. Estimated cost $75,000.

Pump, Motor, Etc.—City of Liberty, Neb., L. J. Knoll, Clk, will receive bids until May 9 for one 40 g.p.m. single stroke pump, 7½ hp. 3 ph., 60 cycle, 220 v. 1200 r.p.m. motor, etc. for proposed waterworks system. Estimated cost $17,900.

Pumping Equipment, etc.—Bd. of Public Works, New Albany, Ind., will receive bids about June 20, for pumping equipment, etc. for proposed sewage system.

Pumping Unit—West Stanislaus Irrigation Dist., Westley, Calif., E. Smith, Secy., withdraw bids of Apr. 6, for vertical pumping unit under contract 21, due to change in construction program.

Pumping Units—Dept. of Water Supply, D. C. Grobbel, Acting Secy., 735 Randolph St., Detroit, Mich., will receive bids until May 15, for twelve motor driven centrifugal pumping units; two 30 m.g.p.d., 200 ft. head; two 40 m.g.p.d., 130 ft. head; four 40 m.g.p.d., 200 ft. head; two 50 m.g.p.d., 130 ft. head and two 50 m.g.p.d., 150 ft. head. for proposed waterworks improvements.

Pumps — Dept. of City Transit, C. E. Myers, Dir., City Hall Annex, Philadelphia, Pa., will receive bids until May 3, for three electrically operated centrifugal pumps with motors, control panels, safety switches, etc. for Broad St. subway.

Pumps, Etc.—Charities Committee, Court House, Syracuse, N. Y., will receive bids until May 2 for a 1000 g.p.m. steam pump and two domestic pumps, etc. for proposed waterworks improvements. Estimated cost $15,000.

Pumps, Motors, Etc.—City Commission, M. B. Herlong, Chn., Jacksonville, Fla., will receive bids until May 27 for two 10,000 g.p.m. vertical centrifugal pumps, direct connected to horizontal electric motors, etc.

Pumps and Motors—City of Carnegie, Okla., five deep well pumps and motors for proposed waterworks improvements. Estimated cost $40,000.

Turbine, Pumps, etc. — Sewerage and Water Board, New Orleans, La., plans to purchase a 15,000 kw. turbine and fourteen 1,000 cu.ft. screw pumps, for sewage treatment work.

Industrial Projects

Ala., Birmingham—STEEL FABRICATING PLANT—Virginia Bridge & Iron Co., C. E. Michael, Pres., 3900 8th Ave. N., is having surveys made for addition to plant. Estimated cost $2,000,000.

Conn., Bridgeport — RADIATOR FACTORY—Crane Co., South Ave., awarded contract for superstructure of a 1 and 3 story factory for the manufacture of household radiators to T. J. Pardy Construction Co., 1481 Seaview Ave. Estimated cost $300,000.

Conn., Hartford — PLANT — L. & H. Motor Co., T. W. Campbell, 90 High St., plans a 3 story, 100 x 300 ft. plant at Broad, Howard and Flower Sts. Estimated cost $350,000. Work will be done under the supervision of E. Winters, 1651 East Grand Blvd., Detroit, Mich., Archt.

Ill., Chicago—SCREW FACTORY—Chicago Screw Co., 3436 Fillmore St., is having plans prepared for a 4 story addition to factory for the manufacture of wood and machine screws, set screws, nuts, etc. Estimated cost $120,000. J. B. Fischer, 140 South Dearborn St., is architect. F. A. Randall, 222 North Wells St., is engineer.

Kan., Wichita—AIRCRAFT FACTORY—Cissna Aircraft Co., First and Glenn Sts., awarded contract for the construction of a factory to consist of five units, two 1 story, 75 x 180 and three 1 story, 75 x 100 ft. to Henrion Improvement Co., Schweiter Bldg. Estimated cost $100,000.

Mich., Detroit—STEEL SASH FACTORY—Detroit Steel Products Co., 2250 East Grand Blvd., is having plans prepared for a 1 and 2 story factory at Mound and Caniff Rds. Estimated cost $250,000. Private plans. Equipment for fabricating steel sash will be required.

Mich., Marysville—AUTOMOBILE TOP FACTORY—Athol Mfg. Co., awarded contract for a 1 story, 30 x 150, 40 x 205 and 90 x 280 ft. automobile top factory to Owen-Ames-Kimball Co., 38 Pearl St., Grand Rapids. Estimated cost $60,000.

Mich., Pontiac — AUTOMOBILE FACTORY ADDITION — Oakland Motor Car Co., is receiving bids for a 1 story, 250 x 450 ft. addition to factory. Estimated cost $300,000. Private plans. Electric motors and motor assembly equipment will be required.

N. H., Laconia—FACTORY and BOILER PLANT—Scott & Williams Inc., 299 Union Ave., awarded contract for a 4 story, 65 x 185 ft. factory and boiler plant to Temple-Crane Inc., 80 Federal St., Boston. Estimated cost $150,000.

O., Toledo—AUTOMOBILE STAMPING FACTORY—City Auto Stamping Co., c/o Langdon, Hohly & Gram, Security Bank Bldg., Archts., awarded contract for a 240 x 300 ft. factory to H. J. Spieker, 1418 Elm St. Estimated cost $250,000.

O., Toledo—SCALE FACTORY—Toledo Scale Co., W. C. Gookin, V. Pres., 3216 Monroe St., will soon award contract for the construction of a plant at Telegraph and Laskey Roads.

Pa., Homestead—PROPELLER FACTORY—Standard Propeller Co., Homestead, is having plans prepared for a 3 story, 130 x 240 ft. factory. Estimated cost $250,000. A. G. Wickerham, 135 East 8th Ave., is architect.

Pa., Pittsburgh—FORGE PLANT—Heppenstall Knife & Forge Co., 4620 Hatfield St., is receiving bids for a 1 story, 60 x 100 and 20 x 120 ft. addition to plant. Estimated cost $40,000. Private plans.

Tex., Yakum — POULTRY DRESSING and COLD STORAGE PLANTS—New York Buyers, Inc., W. A. McShorter, 116 Blue Star, San Antonio, plans the construction of a poultry dressing and storage plant here, $125,000, also three or four poultry dressing and cold storage plants in South Texas. Private plans.